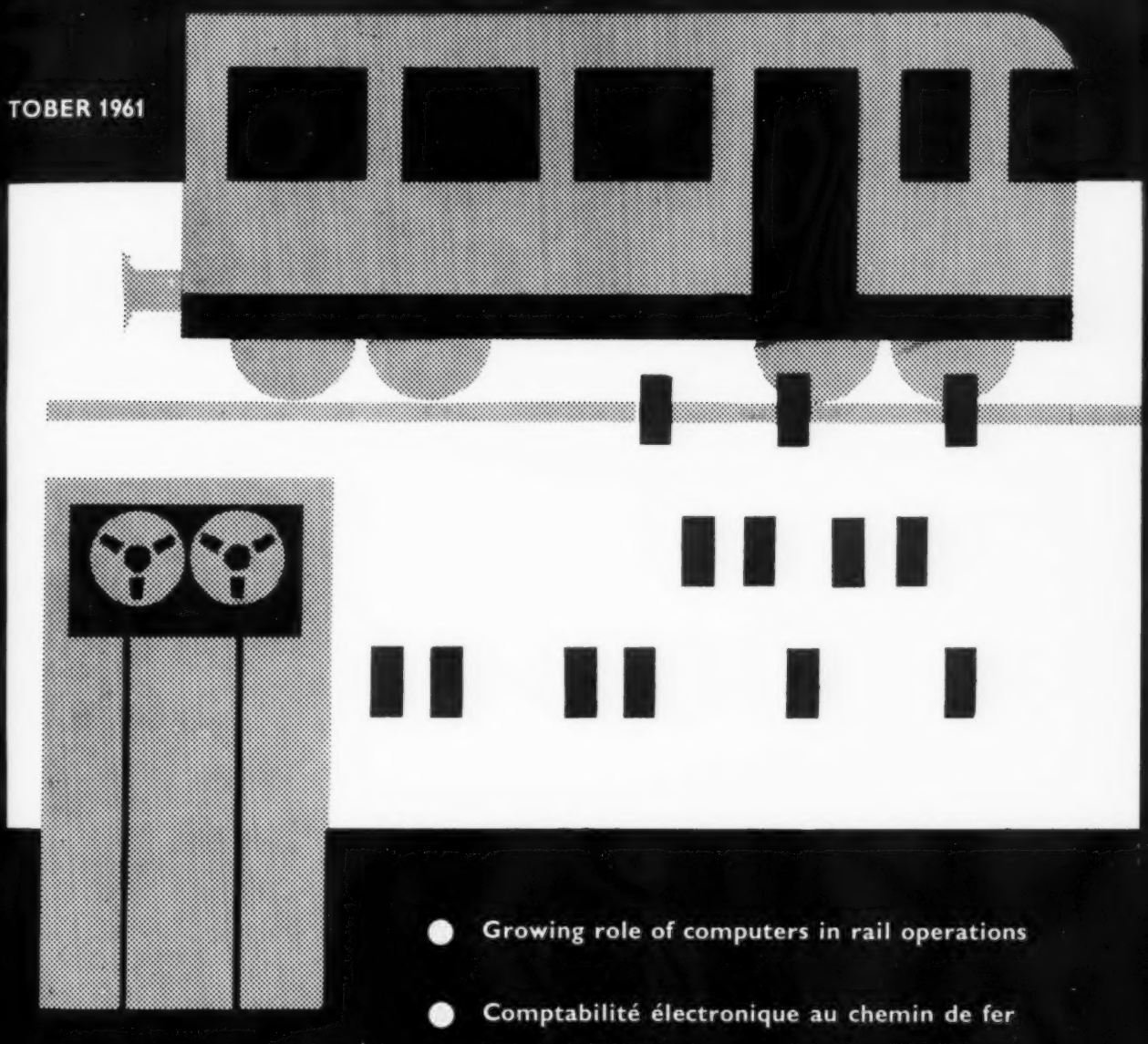
INTERNATIONAL
Railway Journal

TOBER 1961



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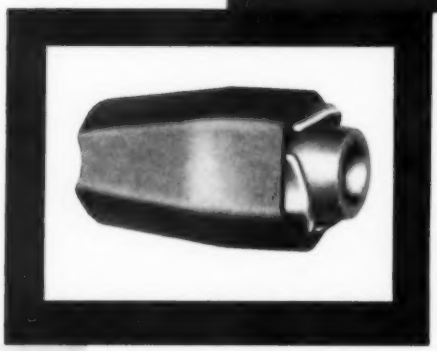

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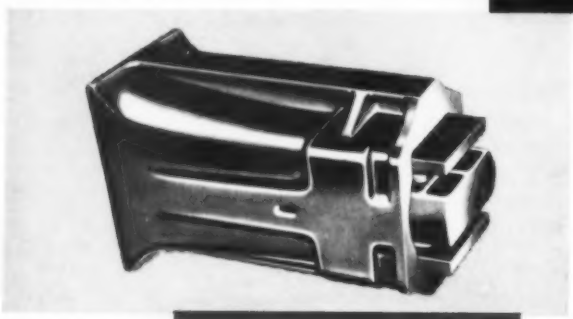

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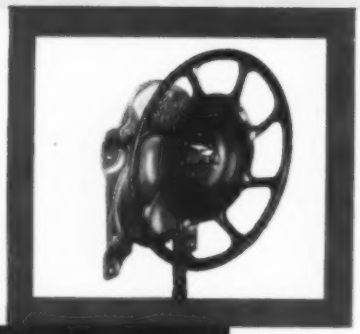

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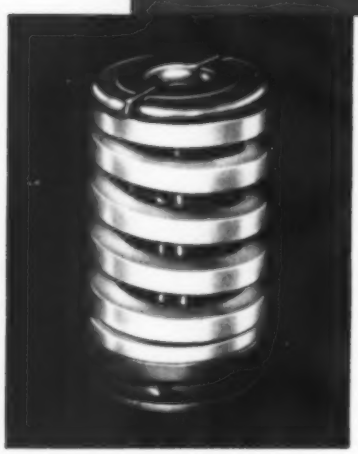

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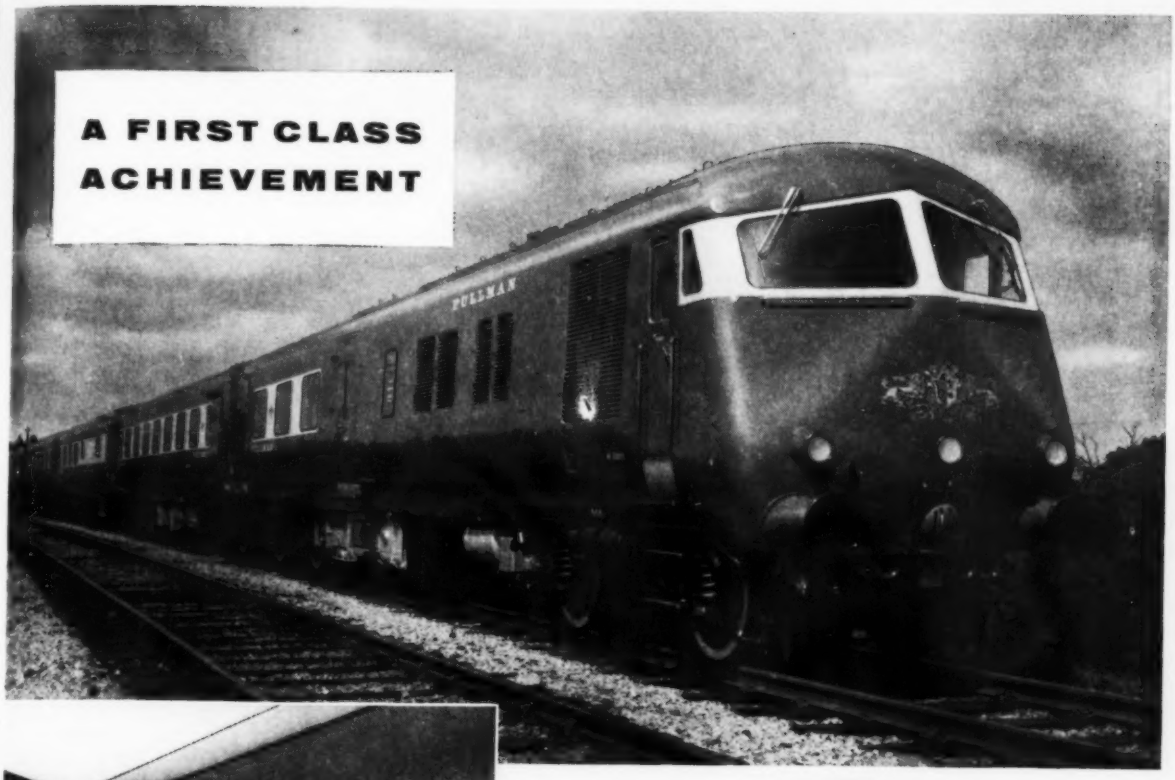

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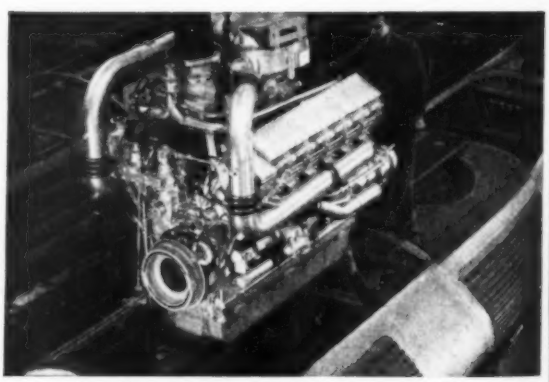

Maybach diesel engine being installed in D800 Class at Swindon.

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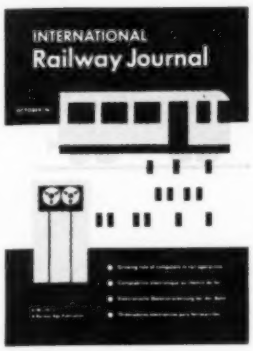

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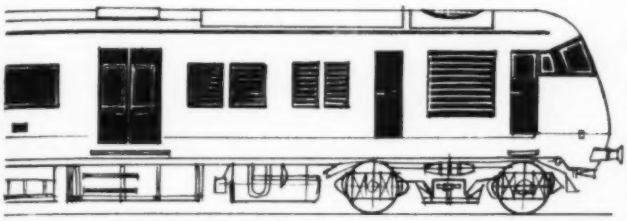

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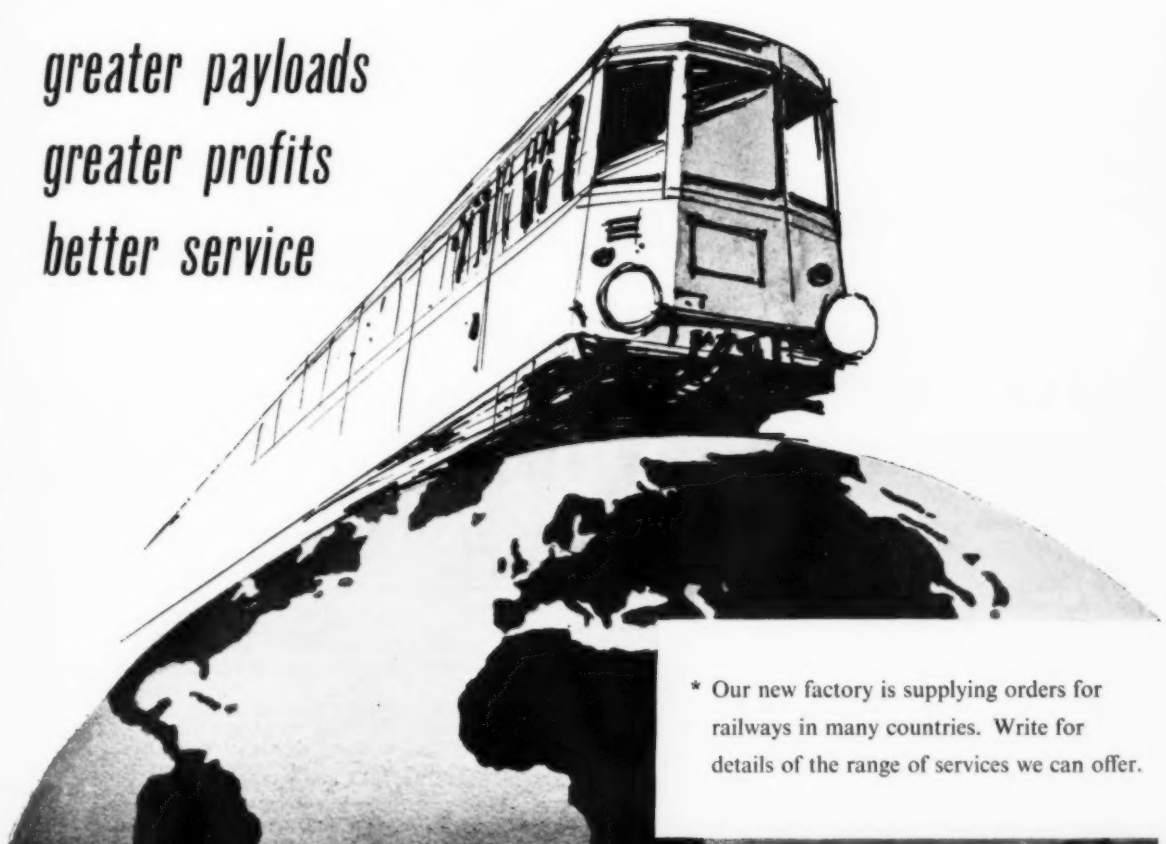

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WORLD REPORT

Australia to Launch Gauge Project

The Western Australian Government and Commonwealth Government have signed an agreement covering the construction of a 644-km standard gauge railway from Kalgoorlie to Perth and Kwinana, replacing the WAGR's present 1.067-m gauge line. Construction will cost an estimated £41 million and will probably begin in mid-1962. The work is associated with plans to establish a £44 million iron and steel industry at Kwinana. The line will connect at Kalgoorlie with the existing Commonwealth Railways' standard gauge line to Port Pirie in South Australia. The WAGR will maintain the remainder of its 1.067-m system and special provision is being made for mixed gauge operations over sections of the new line. The Commonwealth Government will provide £14 million of the funds required for the project; the Western Australian Government, £27 million. The Commonwealth will also provide £1.3 million for the purchase of new motive power and rolling stock for the SAR's 1.067-m gauge Broken Hill-Port Pirie line. Acquisition of 12 900-hp diesel-electric locomotives and 100 55-ton ore cars is envisioned. The Kalgoorlie-Perth standardization work is the second of three projects recommended by a Parliamentary committee in 1957 as a cheap and effective method of overcoming Australia's gauge problem through the linking of all mainland capital cities with a common rail gauge. The first, between Albury and Melbourne, is scheduled for completion early next year, while the third, between Broken Hill and Port Pirie, is the subject of legal action between the Commonwealth and SAR over the allocation of funds. It is anticipated that the Kalgoorlie-Perth project will be completed by 1968.

BELGIUM: Belgian National Railways' 1960 annual report shows a deficit of BF 31.8 million. Optimistic expectations of a slight profit were not realized because of a prolonged strike of industry workers in December. Passenger traffic rose 0.7%, freight traffic, 4%. Total receipts amounted to BF 13,680 million, 260 million less than in 1959. Electrification of the Brussels-Quevy line to Paris will be completed in 1962. Five tri-current locomotives have been ordered for through Amsterdam-Paris service.

BRITAIN: Difficulties over rolling stock, labor and supply of materials have delayed delivery of multiple-unit electric trains to the Eastern Region. Similar sets have been running on alternate lines for some months where difficulties have been encountered with traction motors. The manufacturers, English Electric Co. Ltd., has launched a crash program to handle the necessary changes.

. . . The North Eastern region has installed another automatic passenger car washing plant—the third of its type to be brought into use (p. 43, IRJ, June). The Hull plant has a capacity of 140 cars a day.

. . . BR is spending £1.2 million on new engineering laboratories at Derby. Engineering, vehicle and track, metallurgy and physics divisions will be combined in the new Derby center, which will be equipped with advanced apparatus for testing passenger and freight car underframes, bridge sections, reinforced concrete units and other heavy equipment.

EAST GERMANY: Deutsche Reichsbahn has built three prototypes of a Bo-Bo 15 kv $16^2/_3$ cycle type E 11 locomotive. Built for mixed service, the unit reportedly hauls 600-ton passenger trains at 160 km/h, and 1800-ton freight trains at 100 km/h. The unit, adapted from express train locomotive E 04 built for the Polish Railways, has a length of 16.2 m and an hourly rating of 2800 kw at 98 km/h.

FRANCE: A detailed prospectus of a project for a bridge over the English Channel which would accommodate two railroad tracks has been made public by French interests. The bridge, which would cost an estimated $600 million, thus becomes a serious rival of the project to build a tunnel under the Channel. The tunnel would cost about 40% less, but the sponsors of the bridge project claim it could handle far more traffic which would generate enough revenue in tolls to cover the extra cost. The French government must now decide between the two projects before opening negotiations with Britain.

INDIA: Some £1 billion has been allocated to the Indian Railways under the Third Five-Year-Plan (1961-65). Major objective is self-sufficiency in the manufacture of railway equipment and stores. This is evidenced by the cut in foreign exchange requirements to Rs. 186 crores (£143 million) compared to the Second Plan's estimated expenditures of Rs. 332 crores (£248.5 million). The plan calls for construction of 1,931 km of new line, and the acquisition of 1,700 locomotives (including 300 from abroad), 7,800 passenger cars and 110,000 freight cars. Passenger train-km, which totaled 198 million in 1960-61, are projected at 228 million in 1965-66. During this period freight volume is expected to increase from 154 million tons per year to 245 million.

ISRAEL: An Israeli government committee is investigating a proposal for the construction of a 50-km monorail linking Tel Aviv and Jerusalem. The project, which might be backed by Swedish, Swiss and US capital, would cost an estimated $28.8 million. The beam-supported monorail would have a capacity of 12,500 passengers a day in each direction and would,

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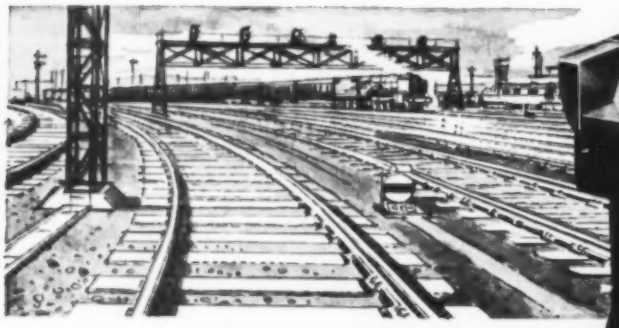

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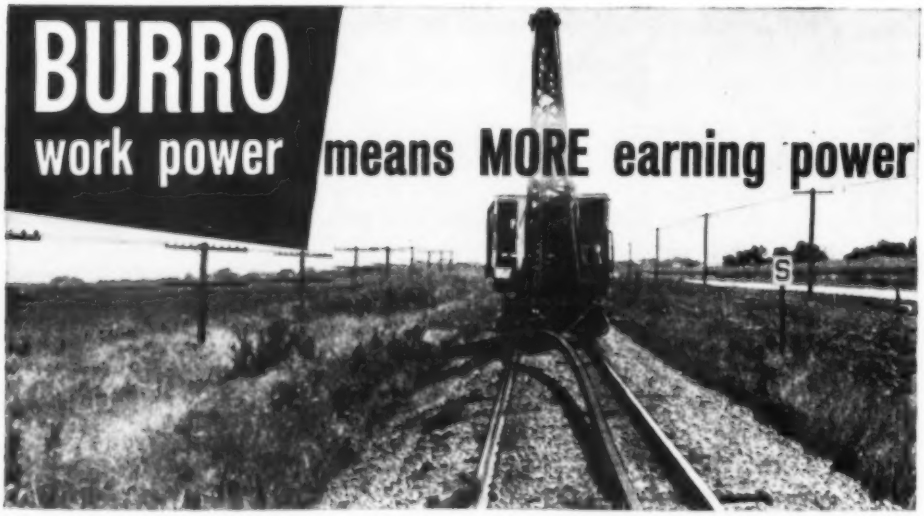

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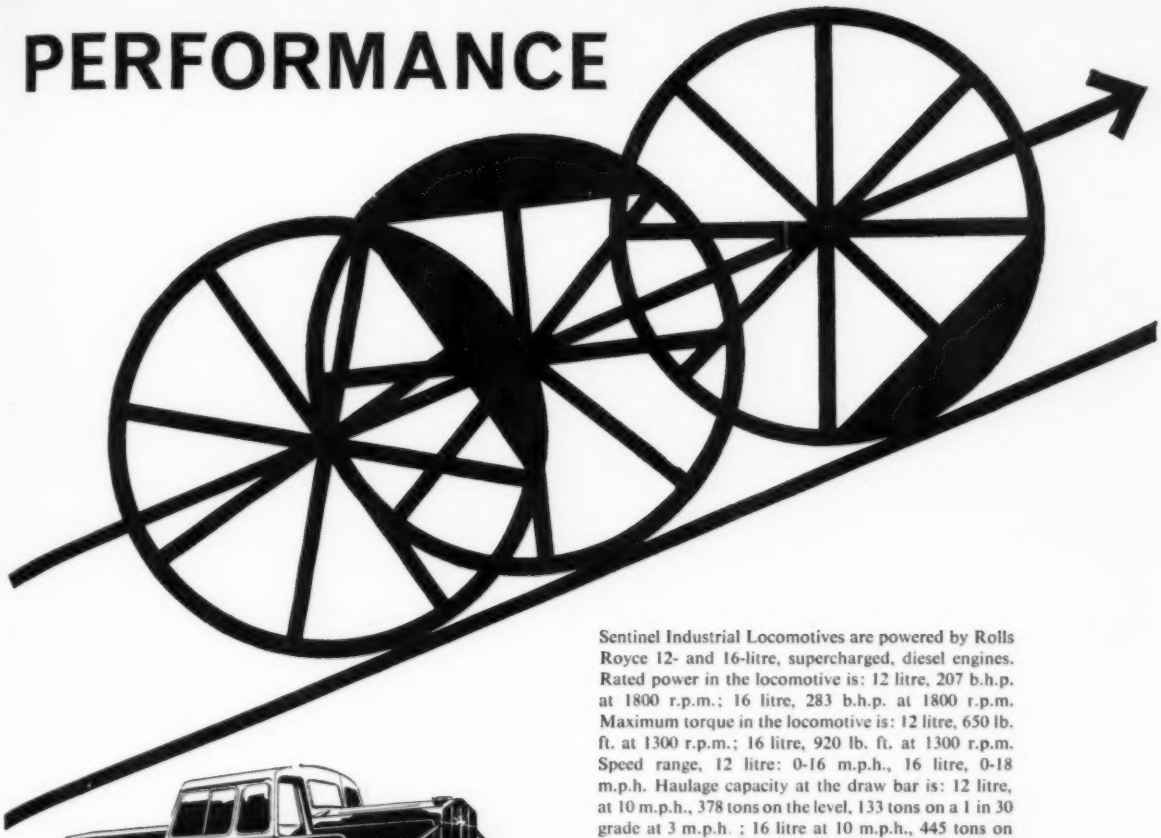

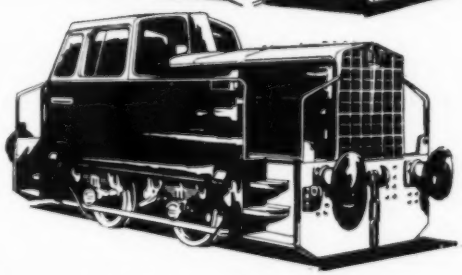

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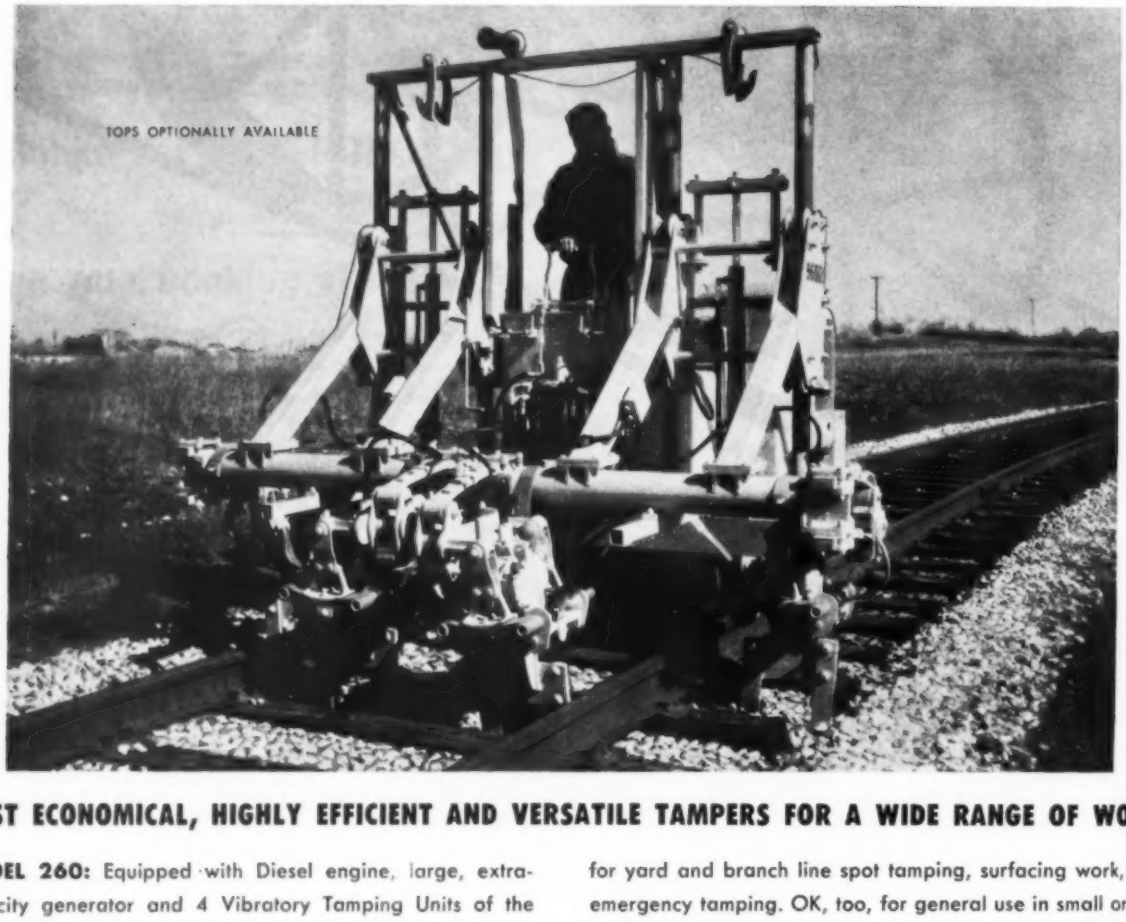

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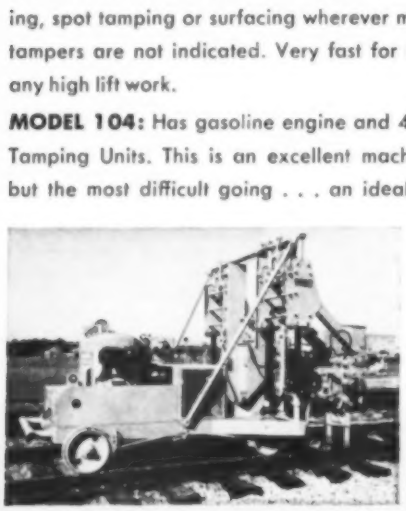
SIMPLIFIED FOR EASY, ECONOMICAL MAINTENANCE Both of these relatively low-priced models are simplified in design, power plant and controls for easy, economical operation and maintenance. Tops optionally available. You'll find the one best suited to your requirements an exceedingly good investment. Detailed information is yours for the asking.



CROSS TAMPING: Jackson Tampers, like no others, are highly efficient in cross tamping because of their unique and powerful vibratory action which uniformly consolidates to maximum compaction a perfect tie bed of ballast proportions right under the rail base where it belongs.

Ad No. 7

JACKSON VIBRATORS, INC

LUDINGTON MICHIGAN, U.S.

(Advertisement)

RÉSUMÉ

2 NOUVELLES BOURREUSES JACKSON – Economiques, très efficaces.

MODELE 260: Moteur Diesel, génératrice à grande capacité et 4 bourreuses vibratoires du type Jackson le plus puissant. La machine a une force de pénétration maximum et manipule facilement du gros ballast. Excellente pour tous travaux d'entretien dans n'importe quelle sorte ou condition de ballast. Rapide pour des nouvelles constructions ou des hautes élévations.

MODELE 104: Moteur à essence et 4 bourreuses vibratoires. Excellent pour tous travaux, sauf les très grosses besognes. Idéal pour le bourrage de petites surfaces et les travaux de nivellement et pour usage général dans des ballasts moux ou à couche mince. Les vérins de levage peuvent être commandés séparément. Modèle simplifié d'entretien facile et économique.

BOURRAGE ENTRECROISE: Seules les bourreuses Jackson sont efficaces dans le bourrage entrecroisé. Leur action vibratoire unique consolide uniformément une assiette parfaite de grandes proportions pour les traverses sous la base des rails.

RESUMEE

2 NEUE JACKSON GLEISSTOPFER – Wirtschaftlich, sehr wirksam.

MODELL 260: Dieselmotor, Stromerzeuger mit hoher Leistungsfähigkeit, mit 4 vibrierenden Gleisstopfmaschinen vom kräftigsten Jackson Typ. Die Maschine besitzt eine maximale Durchdringungsfähigkeit und bearbeitet bequem grosse Bettungsmengen. Ausgezeichnet für alle Unterhaltungsarbeiten in jeder Sorte oder Beschaffenheit der Bettung. Arbeitet schnell für Neuanlagen oder mit hohem Aufzug.

MODELL 104: Benzinmotor und 4 vibrierende Gleisstopfmaschinen. Ausgezeichnet für alle, ausser den schwierigsten, Arbeiten. Ideal zum Stopfen kleiner Flächen und zum Einebnen sowie zu allgemeiner Verwendung in dünnen und weichen Bettungen. Schraubenwinden werden auf Wunsch mitgeliefert. Eine vereinfachte Ausführung für leichte und wirtschaftliche Unterhaltung.

KREUZSTOPFEN: Nur Jackson Gleisstopfer sind für das Kreuzstopfen leistungsfähig. Dank ihrer einzigartigen vibrierenden Leistung konsolidieren sie einheitlich eine perfekte Bettungssohle von grossen Ausmassen unter der Schienenauflage.

RESUMEN

Dos nuevas apisonadoras JACKSON – Económicas y de alta eficiencia. El Modelo 260 tiene motor diesel, generador de gran capacidad y 4 apisonadoras vibratorias Jackson del tipo más potente. Esta máquina tiene una fuerza de penetración máxima y trabaja fácilmente con balasto grande. Excelente para todo trabajo de mantenimiento en cualquier clase de balasto. De acción rápida para obras nuevas o alzamientos grandes.

El Modelo 104 tiene motor de gasolina y 4 apisonadoras vibratorias. Ideal para casi cualquier trabajo, como apisonamientos localizados, trabajos de nivelación y uso general en balastos suaves o pequeños. Gatos elevadores opcionales. De mantenimiento sencillo y económico.

APISONADO TRANSVERSAL: Sólo las apisonadoras Jackson resultan eficientes para el apisonado transversal. Gracias a su excepcional efecto vibratorio el lecho para la traviesa queda perfectamente consolidado, con gran uniformidad en toda el área bajo la base del riel.

JACKSON VIBRATORS Inc.

World Market

▶ *Australia*—Commonwealth Engineering Ltd. of Sydney has received orders for 34 air-conditioned mainline passenger cars for standard gauge operation between Sydney and Melbourne, three power vans and two roomette sleeping cars.

Commonwealth Railways has ordered five 1950/1800-hp Co-Co cab-type diesel-electric locomotives from Clyde Engineering Co. Pty. Ltd.

The Western Australian Government Railways will build at its Midland Junction shops 20 Z-class bogie brakevans, 20 NFA-class four-wheel flatcars and 100 VF-class semi-louvre vans.

The Victorian Railways is calling for bids for the construction of a new station building at its main Melbourne terminal.

▶ *Austria*—Intercontinentale, Oesterreichische AG für Transport- und Verkehrswesen, Vienna, has ordered from Rheinstahl-Siegener Eisenbahnbedarf AG, West Germany, a special car with a capacity of 300 tons. The 20-axle car will be some 45.5 meters in length.

▶ *Canada*—Legislation calling for construction of a new railway line from a point near Grimshaw, Alta., to Great Slave Lake in Northwest Territories, has been introduced in the House of Commons. Construction of the proposed 703-km line would be under supervision of the Canadian National Railways.

▶ *East Germany*—Deutsche Reichsbahn, the state railway system, has ordered 500 tank and freight cars from the Belgium firm of La Brugeoise.

▶ *Great Britain*—British Railways has ordered 50 Roadrailers from Pressed Steel Co., Ltd. A semi-trailer unit capable of operating on rails or highways, the Roadrailer has a capacity of 11 tons and is claimed to have a better payload capacity to tare ratio than the container. Two prototypes have been undergoing tests on BR for sometime.

In connection with the construction of a new marshalling yard at Tinsley, Sheffield, BR has awarded a £1,000,000 contract to Lehane Mackenzie & Shand for the excavation of 4.5 million tons of earth.

United Steel Companies' Steel, Peech & Tozer branch has recently secured export orders totaling £500,000. Included are orders for railway wheels and axles from Mexico, Finland, India and Cuba.

▶ *India*—The government will import 60 meter-gauge and 40 broad-gauge diesel locomotives from the US this year, in addition to seven diesel shunters from West Germany.

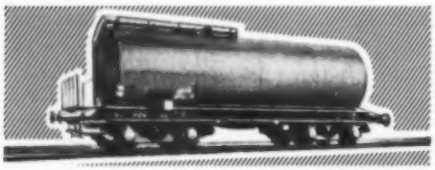
The Indian Railway Board has awarded a £1,000,000 contract to British Insulated Callender's Cables Ltd. for the supply and installation of around 380 track kilometers of overhead equipment for 25kV 50-cycles AC electrification. This is the third contract BICC has received for this type of work since 1958. When completed, the firm will have installed approximately 1,600 kilometers of AC electrification at a total cost of £4.7 million.

Metropolitan-Cammell Carriage & Wagon Co. of Birmingham, England, and Southern Structurals of Madras have signed an agreement to collaborate in freight car construction. Through the agreement, Metro-Cammell acquires a substantial interest in the Indian firm.

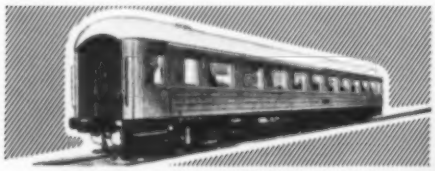
▶ *International Railways of Central America*—Placed a $6.3 million (US) order with General Motors Overseas Corp. for 44 diesel-electric locomotives, contingent on approval of the company's application for a $4 million loan from the Development Loan Fund (US). International Railways operates in Guatemala and El Salvador.

CONTINUED ON PAGE 56

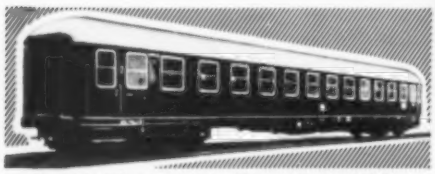
Diesel locomotive of the Danish State Railways, built by A/S Frichs, Aarhus



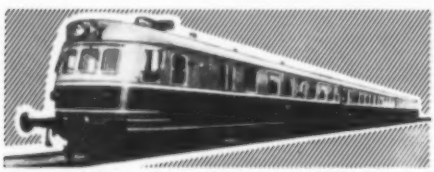
Tank wagon of the Iranian State Railways, built by Linke-Hofmann-Busch, Salzgitter Watenstedt



Passenger coach of the Swedish company TGOJ, built by Kockums, Malmö



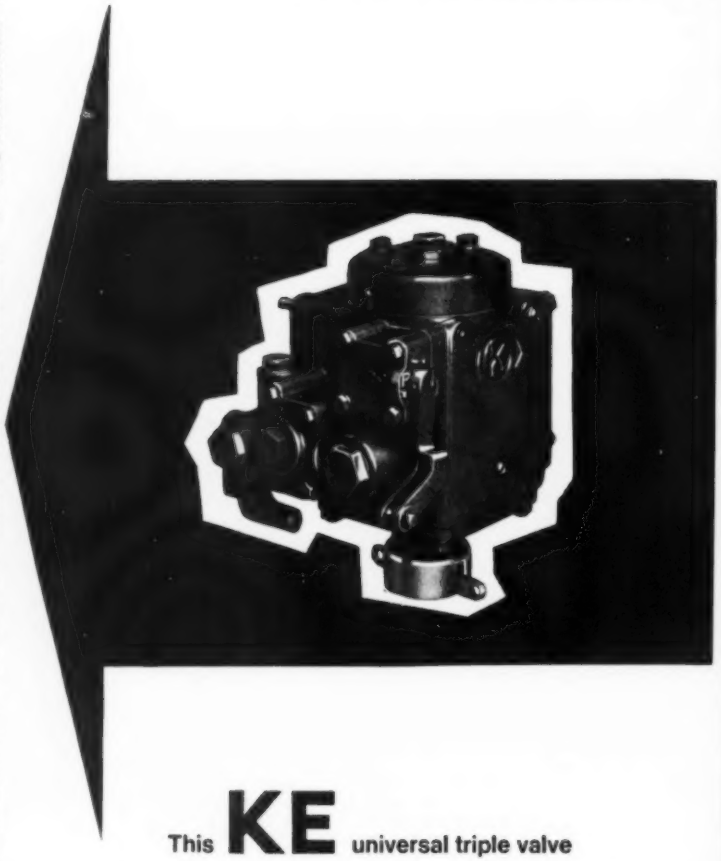
Express train coach of the German Federal Railways, built by Rathgeber, Munich



Railcar train of the Norwegian State Railways, built by A/S Strömmens Vaerksted, Strömmens

Single-engined railbus of the British Railways, built by Waggon- und Maschinenbau GmbH, Donauwörth

Knorr KE Type Air-Brakes for all Rail Vehicles



This **KE** universal triple valve forms the basis of the brake equipment for all types of rolling stock: locomotives, passenger coaches and goods wagons as well as railcars and railbuses. By the attachment of accessory components the action of the valve can be extended to meet the highest demands. The Knorr KE air-brake offers the maximum degree of security and economy. Up to now KE brakes have been supplied to 28 countries in the world.

KNORR-BREMSE GMBH MUNICH W. Germany

Fairmont

HYDRAULIC SLEEPER REMOVER

PUSHES OUT ONE SLEEPER PER MINUTE

WITHOUT TRACK JACKING!

The Fairmont W68 Series A Hydraulic Sleeper Remover makes sleeper removal a simple, fast job, no matter what the track gauge—39⅜" (1 meter) *through* 66" (1.67 meters). This rugged machine, with its 12,000-pound ram pressure, can substantially cut renewal costs. The work cycle is normally one minute per sleeper, and track jacking is unnecessary. Fitted with over-the-rail hooks, it can be operated by one man. It can be quickly taken off the track without auxiliary equipment. Throughout the world more sleepers are removed by Fairmont W68's than any other kind! And agencies around the globe can supply you with a complete line of Fairmont equipment.

RESUMEN

Con la extractora hidráulica de traviesas Fairmont W68 Serie A, los durmientes se sacan con facilidad y rapidez, sea cual sea el ancho de la vía desde 1 hasta 1,67 metros inclusive. Esta poderosa máquina, con una presión de 12,000 libras, reduce considerablemente los costos de la renovación de vías, con un ciclo de una traviesa por minuto y sin tener que alzar con gatos el riel. Basta un solo operario para trabajarla y puede sacarse de la vía sin necesidad de equipo auxiliar. Los equipos Fairmont son los que más se utilizan en el mundo entero para la extracción de traviesas; véalos en las agencias Fairmont en todos los países del globo.

RÉSUMÉ

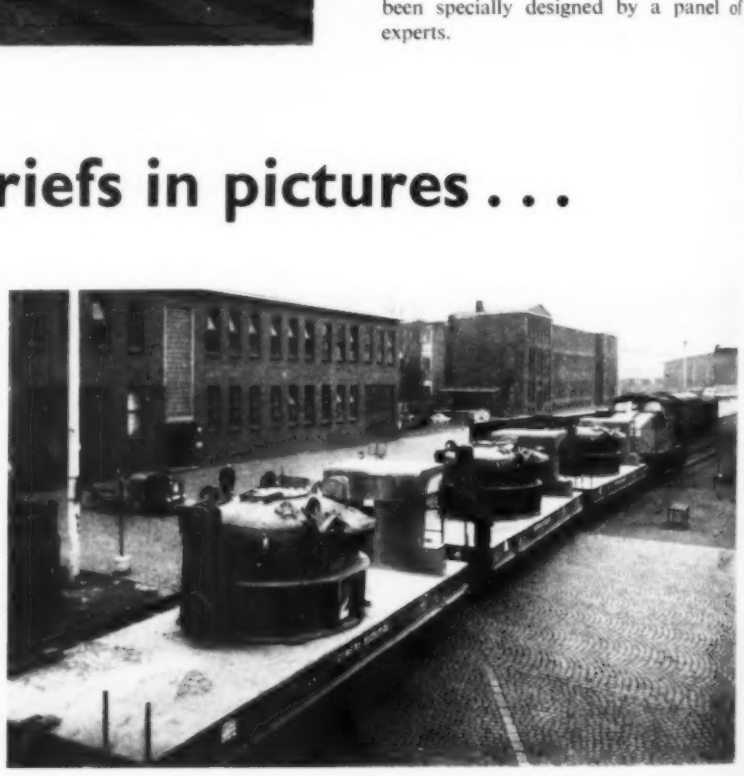
FAIRMONT W68 Série A, l'appareil hydraulique à enlever les traverses, rend la manoeuvre de dépose simple et rapide – de 39⅜" (1 mètre) jusqu'à 66" (1.67 mètre). C'est une machine robuste exerçant une pression de damage de 12.000 livres et qui peut réduire de manière appréciable les frais de remplacement. Le cycle de travail s'effectue à la cadence rapide de 1 traverse à la minute, sans qu'il soit nécessaire de soulever la voie. Comme elle est munie de crochets grippant sur les rails, elle peut être manoeuvrée par un homme seul. On peut l'enlever de la voie sans outillage auxiliaire. Dans le monde entier, on enlève plus de traverses avec les appareils FAIRMONT qu'avec tout autre matériel. Dans tous les pays, il y a des agences qui peuvent fournir la gamme complète du matériel FAIRMONT

FAIRMONT RAILWAY MOTORS, INC. • FAIRMONT, MINNESOTA • U.S.A.

◀ NETHERLANDS: The first of ten new electric four-car trainsets, designated NS 501, will enter service with the Nederlandsche Spoorwegen late in 1963. The prototype, already under test in Holland, will begin regular service runs on the Utrecht–Zwolle line this winter. NS 501 has been developed for fast stopping services and reaches a speed of 120 km/h in only 100 seconds. Speedy movement of passengers at stations has been improved by the use of electro-pneumatic doors for operation by passengers after the driver has released the controls. Features include an illuminated destination panel and a loudspeaker system for communication between driver, guard and passengers. Modern interior decoration and the 281 first and second class seats have been specially designed by a panel of experts.

News briefs in pictures . . .

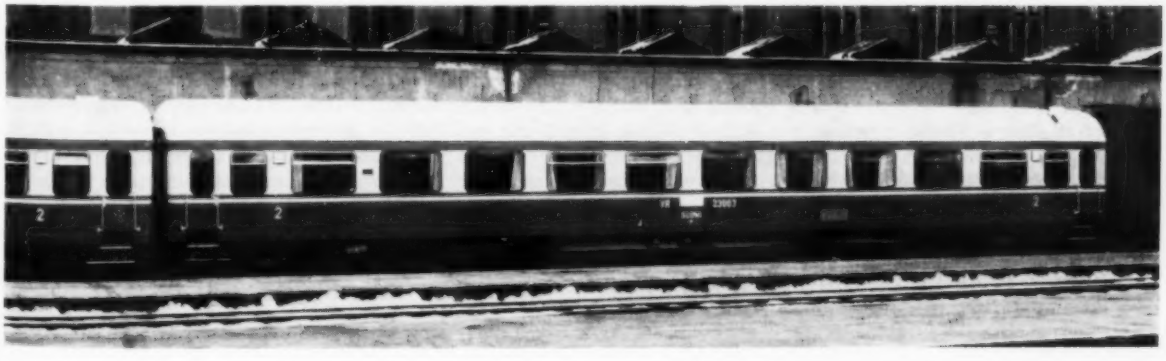
WEST GERMANY: Three liquid pig ▶ iron wagons have been put into service recently by the West German Steelworks, Stahlwerke Bochum AG, of Bochum. They will transport some 120 tons of pig iron a day. The wagons, each with a total capacity of 40 tons, total weight of 82.7 tons (full) and axle weight of 20 tons, were constructed by Siegener Maschinenfabrik GmbH (Siemag) of Dahlbruch, West Germany. They are in the form of platform units mounted with lidded pan containers. Buffer-to-buffer length is 9.6 m, maximum width 3.15 m, maximum height with pan mounted 3.16 m, and gauge 1.435 m. Braking is by Kunze-Knorr; cylinder units; brake coupling hose and hand brake to Federal German Railway Specifications. Springing is by leaf spring.



PORTUGAL: Replacement of aging ▶ steam locomotives continues on the Portuguese Railways (Companhia do Caminho de Ferro Portugueses) and in recent months the first units of a new series of 15 diesel-electric locomotives have been placed in service. Of the total of 15 units, nine have been financed by Eurofima and six by the Portuguese Railways themselves. They were built by the Portugal manufacturer, SOREFAME (Sociétés Réunies de Fabrication Métallique) under license from the French firm, Brissonneau et Lotz, of Paris. Each of the locomotives has a power output of 825 hp and a maximum speed of 80 km/h.

BRITAIN: In connection with new highway construction, British Railways are moving 20,000 tons of cement from Rochester, Kent, to Great Ponton. Cars for carrying the cement have an air-assisted bottom-door discharge. At Great Ponton a siding has been slewed and another regraded so that there is a drop of 3.6 m to the road—sufficient to give a slope of eight degrees from the cement wagons to the inlet on the top of a tanker truck. Temporary prefabricated covers are placed over the discharge and road tanker loading points and a diesel compressor is provided for the air discharge arrangements. A manually operated slide valve opens the doors when cement is to be discharged. A Mucon valve, made of fabric and using the same principle as an iris shutter, allows the operator to regulate the flow. A concertina joint in the top of the flow pipe forms an airtight fixture between the bottom outlet of the car and the flow pipe leading to the road tanker.

UNITED STATES: Delivery of 15 diesel-electric locomotives to the New York Central Railroad was announced recently by Alco Products Inc., manufacturers of the new units. According to Alco this is the first time a 12-cylinder locomotive with a rating of 2,000 hp has been available. The new model—DL-721—will be used for high-speed, heavy-duty freight service. The power plant is the newest version of the Alco Model 251 diesel engine. Developments have increased the horsepower rating from 1,800 to 2,000 hp, Alco reports. The latest engine is known as Model 251-C. Each unit has four traction motors; weighs more than 120 tons; and is 17.37 m long, 3.04 m wide, and 4.41 m high. The new units are geared for 105 km/h, and have 24,040 kg of continuous tractive effort at 40.5 km/h. The DL-721 also incorporates a new adhesion-loss detection system which is better equipped to sense wheel slip, claim the manufacturers.



FINLAND: Maschinenfabrik Esslingen of West Germany has recently supplied the first four passenger cars of a 15-car order to the Finnish State Railways. The new cars are of steel construction, equipped with eighty adjustable seats each and are for use in second-class service. Interiors are well designed and provide a high standard of comfort. The first deliveries will be employed on the Helsinki–Turku route and a spokesman for Finnish Railways has announced that Finland plans to build between 250 and 300 similar coaches under license.

Plans are reportedly being prepared for the construction of a railway line between Kaubiranta and Kolari.

According to statistics released by the Finnish State Railways, total traffic increased by 9% in 1960. Number of tractive units on the FSR now total 1,000, including 658 steam locomotives, 133 diesel units, 23 diesel rail cars and 186 railbuses.

International Railway Journal OCTOBER 1961

Growth of the Computer in Railway Operations

With the rapid technological advancement in the field of electronic data processing systems, railways around the world are turning to the computer for help in solving statistical and operating problems. In recent months a number of railways have installed elaborate data processing systems. The French National Railways have completed installation of a Bull Gamma 60 system in Paris. Both the Swiss Federal Railways and the German Railways have adopted the IBM 7070–1401 combination to handle a variety of data processing chores. In the US and Japan, particularly, more attention is being focused on the potentialities of computers for handling train operations.

One of the most elaborate electronic data processing systems now in operation is the French National Railways' Gamma 60 which has been installed in a building near the Auteuil-Boulogne station at the Porte d'Auteuil. Manufactured by the Bull Machine Co., the Gamma 60 system is composed of:

• A high-speed memory unit which is the central station for all information being fed to or extracted from the other elements. The unit consists of planes of toroids (rings of magnetic material) in ferrite. The direction of the magnetization defines the binary character (0 or 1) recorded on it. By 'reading' the direction of magnetization, the machine 'knows' what information is stored on the toroid. The 24 toroids serve for the recording of a catena which is the basic unit of information used in the machine. Four binary positions are required to represent a digit; six for a letter. Feeding or extracting one catena takes 10 microseconds. The unit has a capacity of 98,304 digits or 65,536 letters.

• A regular memory unit consisting of two magnetic drums turning at 3000 rpm with a capacity of 204,800 letters or 307,200 digits, plus 18 magnetic tapes operating at a speed of 1.90 m per second permitting a catena to be fed or extracted in 266 microseconds.

• An arithmetical computer capable of making additions and subtractions in 100 microseconds, multiplications in 250 seconds, and divisions in 420 microseconds, plus a logical computer.

• Data input and output equipment consisting of two punch card machines with a capacity of 600 cards per minute; one punch tape machine; and six printers with a speed of 1,800 lines per minute.

The Gamma 60 equipment occupies 360 square meters of space and is located adjacent to a stockroom where 15,000 tapes can be stored. Necessary electrical generating equipment and air-conditioning equipment has been installed in the basement of the building.

Since April of this year the Gamma 60 has been employed to handle the payroll for SNCF's 350,000 employees, plus social security payments, pension payments and statistics on car-load traffic and purchasing. In the future, says SNCF, the Gamma 60 will be used to handle problems of general accountancy, stock and movement control, budgetary-control and cost-price control.

The German Federal Railways have installed an IBM 7070 and two 1401 data processing units which will be put to work on traffic and material control problems.

The 7070 is a high-speed, transistorized computer, capable of making 834,000 additions of 10 digit figures in one minute. The computer can handle input and output operations simultaneously. A so-called preference-assimilation system allows operators to extract information in the desired order. The 7070's magnetic core has a capacity of 5,000 to 10,000 words. Units of information can be extracted in 6 microseconds.

The 1401s have a reading capacity of 48,000 cards per hour, a punching speed of 15,000 cards per hour (for magnetic tapes the reading and printing speed is 62,500 symbols per hour) and a printing speed of 36,999 lines per hour.

Considering the high cost of such installations, it is obvious that the technical and organizational possibilities have to be carefully examined from the standpoint of economical application. One inherent danger, in view of the far reaching capacities of modern electronic data processing systems, is that the system might be employed for the performance of tasks of little value, thus only increasing the flood of papers already circulating through the offices of most railways. Any railway introducing electronic data processing, therefore, must analyze carefully in what form and to what extent any item of information is actually needed in order to eliminate programs that are not essential.

The Swiss Federal Railways, for example, conducted extensive tests and inquiries before plunging into the field of electronic data processing. Convinced that computer systems could deal in an efficient and economical manner with a large number of assignments in the technical, operational, commercial and administrative sectors, CFF installed an IBM 7070-1401 system in April of this year.

In the immediate future, the Swiss Federal will use its new EDP system to (1) increase the productivity of individual terminals and stations by turning over clerical and administrative chores such as rate or fare calculations, accounting and the preparation of other data to the computer center; (2) provide management with current data on the operation

of the railway; (3) solve daily problems of management and operations such as the rational distribution of empty cars and the streamlining of purchasing procedures.

Following work now in progress on Swiss carload traffic and car-hire charges, a program for the handling of the CFF payroll will also be setup.

Also assigned for the first year of operation are two problems which should fully test the capacity of the Swiss Federal's IBM system. One of these stems from the Federal Decree of 5 June 1959 regarding the relationship of freight rates charged by the privately-owned railways of Switzerland to those of the Swiss Federal Railways. The 'levelling out' of charges between the private and government carriers called for in the decree necessitates the recalculation of tariffs between some 1,200 points and the determination of approximately one million 'shortest routes'—a job that will now be handled by the Swiss Federal's electronic data processing equipment.

The second project relates to the accounting work connected with the international refrigerated equipment operated by INTERFRIGO. Waybills and other necessary data are collected at departure and arrival stations as well as at frontier points. The data will now be processed by the CFF at its computer center and the results transmitted to INTERFRIGO. Aside from showing the high degree of cooperation between European railways, this latter example points to the potentialities of computers for automatizing administrative work on the international level.

A key step in the development of the Canadian National Railways' extensive data processing system was taken this summer with the installation of an IBM 7070 magnetic tape computer in CNR headquarters at Montreal. IBM 1401 machines are being placed in each of CNR's regional headquarters at Winnipeg, Moncton, Toronto, Edmonton and Montreal to work in conjunction with the Montreal-based 7070.

When the system is completed, it will speed up and economize the handling of information for all phases of railway operation such as car tracing, revenue accounting and operational research. Payroll checks will be listed, printed and sorted in almost one-fifth the time it takes at present.

CNR yard and freight offices across Canada, now gradually being mechanized, will feed information on punched cards to the regional 1401s. The regional computers, able to process information on magnetic tapes or punched cards, will

CONTINUED

Les chemins de fer cherchent dans l'électronique appliquée la solution de leurs problèmes

Vu les progrès rapides de l'électronique appliquée, un nombre croissant de chemins de fer utilisent des ensembles électroniques pour résoudre leurs problèmes de statistique et d'exploitation. Ces derniers mois, divers réseaux ont mis des ordinateurs en service, notamment la Société nationale des chemins de fer français, qui a installé à Paris un système Bull-Gamma 60, les Chemins de fer fédéraux suisses et le Chemin de fer fédéral allemand, qui ont adopté le système combiné IBM 7070-1401 pour toutes sortes de travaux. Le "Canadian National Railway" a pourvu son administration centrale de Montréal d'un appareil IBM 7070; il est en train d'installer des machines IBM 1401 dans ses arrondissements. Le "Canadian Pacific Railway" a monté un convertisseur bande magnétique—bande de papier à trois directions, qui relie son réseau de télescripteurs à une machine comptable IBM 705, modèle III. Les ensembles électroniques se perfectionnant toujours plus, les chemins de fer examinent maintenant la possibilité de les utiliser aussi pour la circulation des trains, ce que l'auteur de l'article expose en détail.

Eisenbahnen suchen Lösung ihrer Probleme in angewandter Elektronik

Die rasche Entwicklung auf dem Gebiete angewandter Elektronik veranlasst eine wachsende Anzahl Eisenbahnen, ihre statistischen und betrieblichen Probleme mit der Hilfe elektronischer Datenverarbeitungsanlagen zu lösen. In vergangenen Monaten nahmen verschiedene Eisenbahnen solche Anlagen in Betrieb, so die Nationalgesellschaft der Französischen Bahnen, die in Paris ein Bull-Gamma-60-System installierte, sowie die Schweizerischen Bundesbahnen und die Deutsche Bundesbahn, die das kombinierte IBM-7070-1401-System für allerlei Datenverarbeitungen einsetzten. Die Canadian National Railway versah ihre Zentralverwaltung in Montreal mit einer IBM-7070-Anlage und steht im Begriff, IBM-1401-Maschinen in ihren Kreisverwaltungen einzurichten. Die Canadian Pacific Railway stellte einen dreidirektionalen Magnetband/Papierband-Umwandler auf, der ihr Fernschreibernetz mit einem IBM-Computer 705, Modell III, verbindet. Mit dem Auftreten immer weiter entwickelter Anlagen dieser Art prüfen die Eisenbahnen nun die Möglichkeit, die elektronischen Datenverarbeitungsmaschinen auch in den Dienst der Zugverkehrsabwicklung zu stellen, was in vorliegendem Artikel ausführlich behandelt wird.

Ferrocarriles optan por complejos electrónicos

Adelantando rápidamente la tecnología en el campo de complejos electrónicos, los ferrocarriles del mundo entero utilizan más y más el ordenador para resolver sus problemas estadísticos y de operación. En los últimos meses gran número de ferrocarriles han instalado nuevos complejos electrónicos. Los FC nacionales franceses han instalado un nuevo ordenador BULL Gamma 60 en París. Tanto los FC federales suizos como los FC federales alemanes han optado por la combinación IBM 7070-1401 para desempeñar gran diversidad de actividades. En el Canadá los FC nacionales han instalado un ordenador magnético 7070 en la oficina principal en Montreal y se está instalando un IBM 1401 en cada una de las oficinas regionales. El FC Pacífico canadiense ha instalado un convertidor tridireccional de cinta magnética en la de papel, el que enlaza su sistema de comunicación teleimpresor con el ordenador IBM 705 modelo III. Hoy día los ferrocarriles estudian la posibilidad de utilizar ordenadores para las operaciones de trenes. En este artículo se discute este tema.

Above are consoles of the Bull Gamma 60 data processing system in use on the French National Railways (left) and of the IBM 7070 system (right) installed by both the Swiss Federal and the German Federal Railways

COMPUTERS CONTINUED

quickly produce the statistics required for regional operations. They will also pass on information to the key 7070 computer at Montreal on magnetic tape for further processing and analytical studies.

A tri-directional magnetic tape, paper tape converter is speeding up the flow of data into and out of Canadian Pacific's Montreal computer center. The converter links the road's teletypewriter communications system with the magnetic tape input-output of the IBM 705 Model III computer. The converter has replaced some former punched card input-output requirements.

The new machine converts information received from the field on teletypewriter paper tape to magnetic tape for processing on the high-speed computer, converts processed information on magnetic tape to paper tape for relay via teletype to other offices, and can select out information from one reel of magnetic tape and reproduce it on another.

The converter "... will provide the facility of paper tape to magnetic tape conversion and vice versa, eliminating the necessity of entering and leaving the computer installation via punched cards," states E. A. Leslie, CPR's vice-president, accounting. The railroad has 68 local reporting centers connected via teletype to four regional data centers. At these centers, the data is processed for transmission via teletype and IBM transceiver to the Montreal computer center.

The Digitronics Corp. converter, D106, provides both transverse and longitudinal parity checks. It has two magnetic tape units, one paper tape unit and two memory units. Associated with the converter are two paper tape punches that operate at 1,000 words per minute. The converter can read paper tape and place data on magnetic tape at a rate of 500 characters per second, equivalent to about 6,000 words per minute. When converting from magnetic to paper tape, the unit reads the magnetic tape and feeds data into memory, which feeds data directly to the paper tape punch. The memory acts as buffer storage, because the converter can read magnetic tape much faster than the paper tape can be punched.

A third function of the converter is to transfer data from magnetic tape to magnetic tape with selective action. Thus the unit will read one magnetic tape, selecting certain data and putting it on a second reel of magnetic tape. This type of conversion could prove helpful in handling movement data, particularly concerning movements of certain types of freight cars. For example, the converter can read train consist tapes and select the data concerned with covered hoppers, DF box cars, etc., and place this movement data on a separate magnetic tape. This selective reading can also be accomplished on the paper tape. Thus complete selectivity is available from paper tape to magnetic tape, from magnetic tape to paper tape and from magnetic tape to magnetic tape.

British Railways, whose experience with punch cards goes back to 1906, now has more than 80 punch-card installations handling routine statistical chores. But with the new generation of more sophisticated computers becoming available, BR is rapidly turning its attention to more complex matters. One is traffic costing, a subject of prime concern to Dr. Beeching, new chairman of the British Transport Commission.

Methods of programming and technique are now being evolved to provide management with an analysis of traffic over sections of line. At the same time, a system for automatic rating and charging is also being developed. BR's freight rate structure is based on a weight and mileage system. The weights of consignments are readily available, but the distance factor has proved more complicated. However, a system solving it has reportedly been designed and a computer program which shows promise of being a sound solution to an old problem is in its final stages.

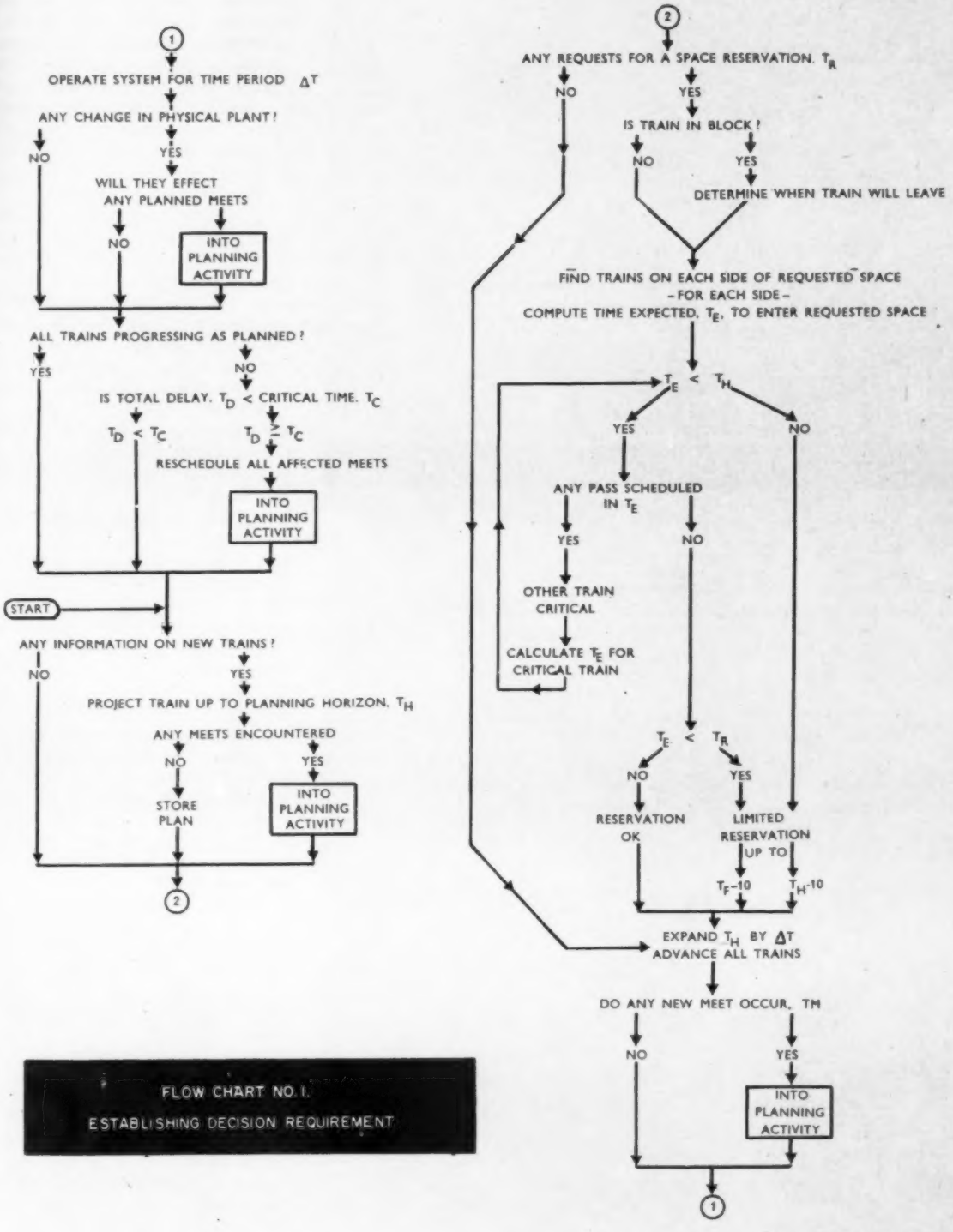
Railway equipment manufacturers are also turning to computers to speed-up processing of orders and improve inventory control. In the US, for example, Alco Products, Inc., has installed an IBM RAMAC 305 electronic computer at its Schenectady, N.Y., headquarters. The 305, which can store up to 5,000,000 electrical impulses of information on 50 'memory' discs, is linked with Alco's three widely-separated warehouses by teletype printer and tape connections. Orders for locomotive parts received at one of the warehouses is transmitted over teletype to the control center at Schenectady. The information is then fed into the computer, which produces a punched tape that is relayed back to the warehouse to direct the shipment of the necessary part. In addition to speeding the processing of orders, the computer also produces the invoices and other papers needed for billing the customer, and continually adjusts its inventory account for each part shipped.

With the installation of more modern and elaborate data processing equipment, railway systems in many countries are now turning their attention to the potential use of computers in train operations.

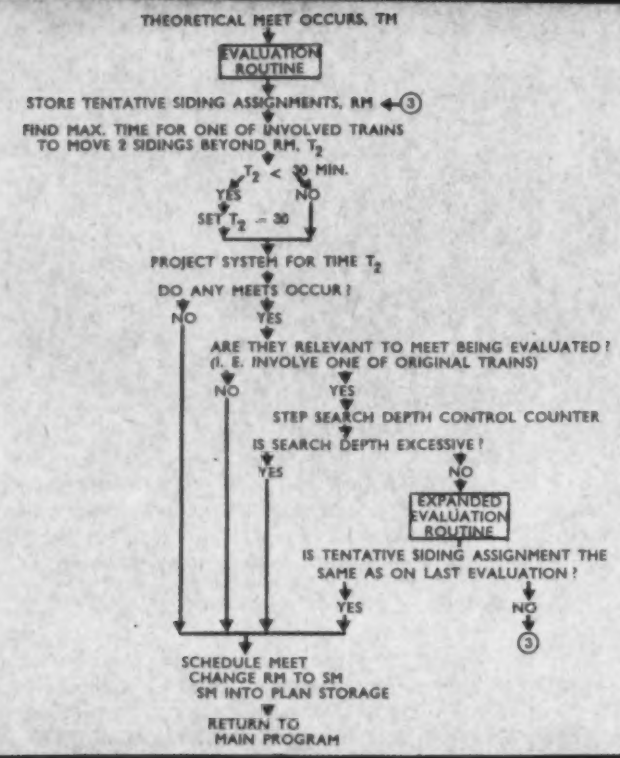
This subject, in fact, was explored in some detail at a recent meeting of the American Institute of Electrical Engineers Land Transportation Committee. John L. Gable, operations research

CONTINUED

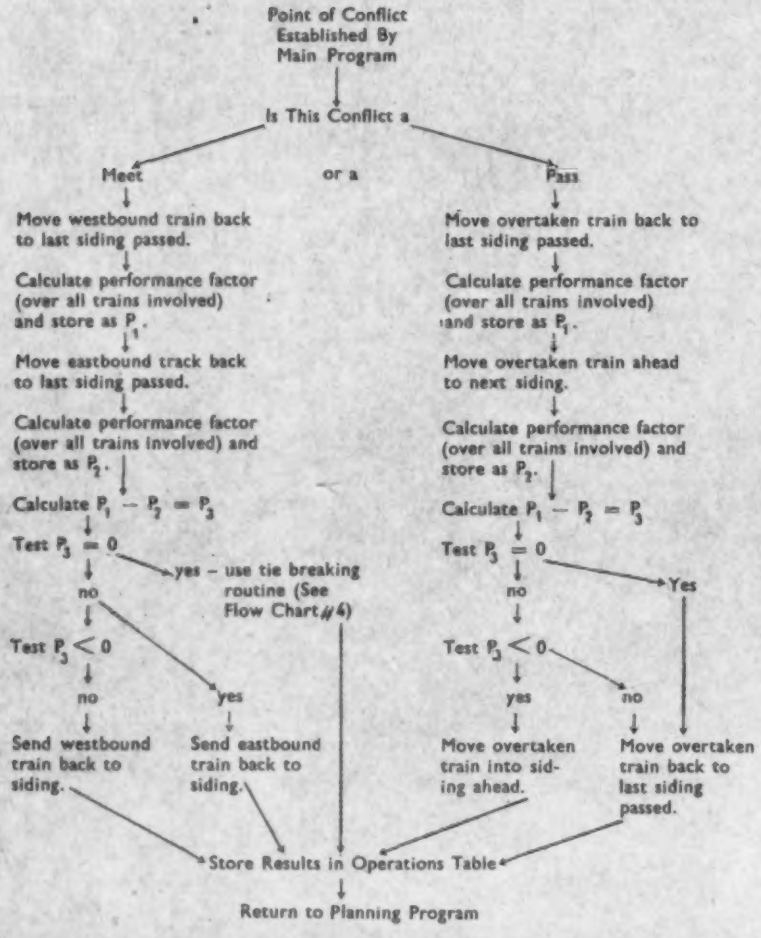
Computer Simulation of CTC Dispatcher



FLOW CHART NO. I.
ESTABLISHING DECISION REQUIREMENT



FLOW CHART NO 2 TYPICAL PLANNING ACTIVITY


Point of Conflict Established By Main Program
Is This Conflict a
Meet
or a
Pass
Move westbound train back to last siding passed.
Calculate performance factor (over all trains involved) and store as P_1.
Move eastbound track back to last siding passed.
Calculate performance factor (over all trains involved) and store as P_2.
Calculate $P_1 - P_2 = P_3$
Test $P_3 = 0$
yes – use tie breaking routine (See Flow Chart #4)
no
Test $P_3 < 0$
no
yes
Send westbound train back to siding.
Send eastbound train back to siding.
Move overtaken train back to last siding passed.
Calculate performance factor (over all trains involved) and store as P_1.
Move overtaken train ahead to next siding.
Calculate performance factor (over all trains involved) and store as P_2.
Calculate $P_1 - P_2 = P_3$
Test $P_3 = 0$
Yes
no
Test $P_3 < 0$
yes
no
Move overtaken train into siding ahead.
Move overtaken train back to last siding passed.
Store Results in Operations Table
Return to Planning Program

FLOW CHART NO 3 TYPICAL EVALUATION PROCESS

COMPUTERS CONTINUED

analyst, The Milwaukee Road (US), gave this description of how a digital computer can aid a train dispatcher in controlling a single-track rail line with CTC.

"The use of a digital electronic computer to simulate a CTC dispatcher raises one pecularity which should be noted. In real life, time is an on-going, continuous thing; the dispatcher can react to things as they happen. But the computer will take discrete increments of time—as fine or rough as we want them, depending upon the fineness we want in simulation—and analyze the events that occurred during the time interval.

"During our contemplated simulation, the computer will cycle by moving the time threshold (the present movement) forward by 'delta t' minutes. It will then progress all the trains across the system by the proper amounts. The program will then review the data for the time period to see if any of the following types of events have occurred (flow chart 1):

"First, the computer will check to see if any changes in the physical plant have taken place. Have any switches or signals become inoperative; have any sidings been blocked by cars set out for hot-boxes? If so, the siding is no longer usable for running meets, though it may still be utilized for a semi-saw-by meet. Will any of these facts cause the dispatcher to change his plans?

"Second, are there any trains which are falling behind their contemplated performance? If so, is their delay sufficient to require a rescheduling or replanning of meets?

"Then the computer would project the performance of all the trains into the future for time 'delta t.' It would then investigate these anticipated movements to see if any theoretical meets occurred. If they did, the computer would then have to go into a planning routine to assign the meet to a siding.

"Finally, the computer would investigate any requests to reserve a block of time on a segment of the railroad for use by a switch or maintenance crew. Depending on the priority of the request, will the dispatcher have to change his plans?

"A plan is a projected or anticipated course of action. For any particular instant, with its particular set of trains, locations, directions and velocities, a large number of courses of future action are available. Some plan evaluation technique—analogous to the use by a human of judgment criteria—will have to be developed. These are three levels of activity which must be carried on by the decision simulation program: (1) establishing decision requirements—flow chart

1; (2) planning activity—flow chart 2; (3) plan evaluation and choice—flow chart 3.

"Let us proceed by investigating the type of elevation criteria which might be developed for discriminating between alternate choices when a theoretical meet or pass has appeared. Consider for a moment a train performance ratio—

$$P = \sum_{i=1}^{m} W_i \sum_{j=1}^{n} \frac{T_{ij}}{t_{ij}}$$

Where:

- t_{ij} is the actual time, including delays, required for a train to traverse a segment of track (note that t_{ij} is always greater than zero).
- T_{ij} equals expected best performance of a train with no delays—includes factors for engineer capabilities, weather and track conditions.
- i equals train number.
- j equals track segment number.
- m equals number of trains being considered in planning a group of meets.
- w_i equals train priority weighting factor.

"The train weighting priority factor, w_i allows us to place economic value on the advancement of passenger trains before freight trains. It also allows for the following; a passenger train might be held in a siding for 3 min. while a freight train continued on the last half mile to get into a siding, rather than holding the freight train at a siding 10 miles down the track during the 15 or 20 min. necessary for the passenger train to cover that distance. The weighting factor is of prime importance and seems to have some correspondence to the judgments reached by train dispatchers. The following weights are suggested for the first runs of the simulation: 1st train class, w_i is 1.0; 2nd class, w_i is 0.6; 3rd class, w_i is 0.4; and 4th class, w_i is 0.2.

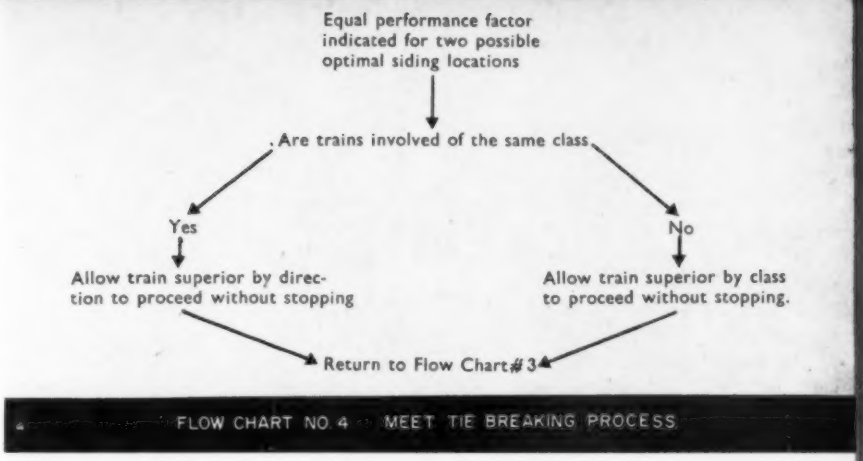
"Concerning our theoretical meet; if it occurs at any unoccupied siding, we can schedule the meet right there. If the meet would occur between two sidings, the program has to decide which one to choose in order to minimize delay time or maximize train performance. How this is done is shown in flow chart 3.

"The program developed first places a train into one of its sidings and then evaluates the performance of the system. Because it takes a while for a stopped train to get speed back up, the time span included in the determination of the performance ratio should extend enough beyond the contemplated meet so that both trains will again be performing at their capabilities.

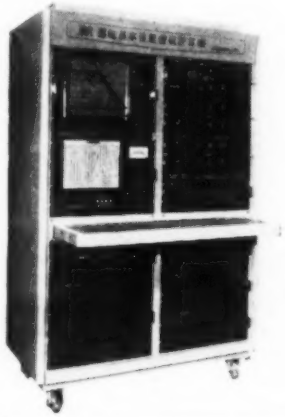
"The program then does the same thing using the siding on the other side of the place where the theoretical meet should have taken place. It evaluates the effect upon performance of having the meet in this siding. It then develops the difference in performance between these two decisions. If this difference is sufficiently great, it establishes this theoretical meet at the most desirable siding without regard for searching further for other possible good meets. Reasoning is that if the meet is going to occur within 100 yards of a siding, it does not pay to search beyond this for a good siding location. However, if a theoretical meet should appear to occur five miles out between two sidings, ten miles apart, then later events are likely to have a more substantial effect upon the economic desirability of where the meet is made.

"After a theoretical meet has been tentatively assigned to a siding, the program proceeds to calculate the time required for each train to progress through two sidings beyond this tentative position. If this time is less than 30 min., a minimum search value of 30 min. is used. All other trains upon the railroad are then projected ahead for this 30 min. or passing area search time. If any meets occur during this period of time and if they are

CONTINUED ON PAGE 58


Equal performance factor indicated for two possible optimal siding locations
Are trains involved of the same class
Yes
No
Allow train superior by direction to proceed without stopping
Allow train superior by class to proceed without stopping.
Return to Flow Chart# 3

FLOW CHART NO. 4 MEET TIE BREAKING PROCESS



Fundamental running curve computer used on Japanese National Railways

Block Diagram of Train Performance Calculator

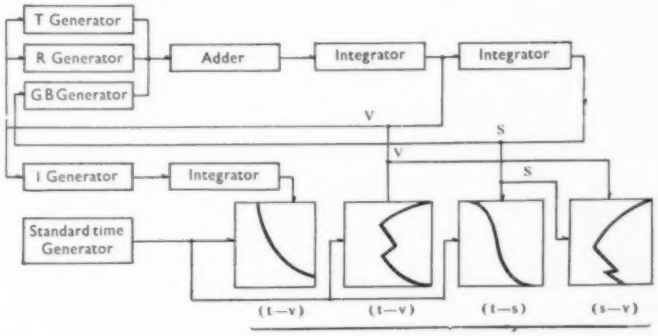


Chart Group

New multiple unit railcar set – the "Phoenix" – features panoramic observation cars similar to Italian ETR 250

Japan: New Growth Is Planned

Japan's railways, caught in a traffic jam of staggering proportions, have embarked on a massive modernization and expansion program. Their "new look" will cost more than 1,000,000,000,000 yen ($2.8 billion US)—a reasonable price, economists say, if it can close the widening gap between transportation supply and transportation demand that has threatened to slow down the nation's booming economy.

Big problems require big—and often costly solutions. The measures now being taken by Japan's railways to cope with a worsening transportation crisis are both big and costly.

Japanese National Railways, the 20,000 km-route government-owned system, will spend nearly 200 billion yen annually ($556 million US) for new equipment and modernized facilities during a five-year program that began 1 April 1961. This is twice the normal rate of spending.

Thousands of new freight cars will be added to JNR's present 113,000-car fleet; diesels will replace most of the 4321 steam locomotives that were in operation in 1960; 22% of total route-kms will be electrified; 18.5% will be double-tracked.

Japan's 13 major private railways, meanwhile, have replaced an old five-year plan with a three-year program that triples the former rate of spending. The total private-railway investment in new plant and equipment will amount to 133.5 billion yen ($371 million)—or 44.5 billion yen ($123.6 million) annually.

For railway suppliers, as well as for the railways themselves and their 578,000 employees, this sharply-increased rate of investment represents a major economic breakthrough. Considerable emphasis will be placed on the acquisition of new rolling stock and motive power, most of which will be furnished by such major producers as Mitsubishi Electric, Nippon Sharyo, Kawasaki Rolling Stock, Tokyu Car, Tokyo Shibaura Electric, Mitsubishi Heavy Industries, Kisha Seizo, Kinki Sharyo, and Fuji Car.

Manufacturers are already predicting that 1961 will see the largest volume of railway-equipment orders in the industry's history. The current outlook is for orders this year totaling 14,900 units—locomotives, passenger cars, and freight cars—valued at 85 billion yen, a 13.6% increase over fiscal 1960. Most of this, of course, will come from JNR, which is spending 50 billion yen ($139 million) on rolling stock this year.

High priority is being assigned to freight-car acquisitions, and for good reason.

On an average day, Japan's railways are not able to furnish sufficient freight cars to meet the requests of shippers. In 1959, the nation's average daily freight-car requirements came to 50,962 units; the average daily freight-car supply was 29,728 units. The gap is believed to be considerably wider today.

This situation has developed despite the fact that the railways are carrying a declining share of the nation's total freight and passenger traffic. In 1955, the railways' freight ton-kms amounted to 52% of the total; by 1959 their share was down to 43.3% and it is now estimated at around 40%. In 1955, the railways furnished 80% of the nation's total passenger-kms; in 1959, they furnished only 74%.

In a swiftly-rising economy, however, their actual volume of traffic has climbed, and steeper increases are predicted in the years just ahead.

Economists estimate that railway freight volume in 1970 will amount to 82.4 billion ton-kms, compared with 1959's 50.5 billion—though by that time the railway share of the total will have dropped to 38%.

Also in 1970, say these economists, the railways will be called upon to furnish twice as many passenger-kms of service as they do today.

The railway problem, while essentially quantitative, also has its qualitative aspects. While the railways are offered more freight of all kinds than they can easily handle, they have seen a widening

Interior of Phoenix observation car

stream of valuable traffic move over to highway carriers.

Airlines have made similar inroads on passenger traffic. The railways have more passengers on the whole than they can easily accommodate—but increasingly, Japanese making long-distance trips have been switching to air travel.

Thus the railways have been confronted with a double challenge: meeting the basic transportation demands of an expanding economy, and at the same time creating services which are sufficiently attractive to retain the best paying traffic.

Up to now, the railways have lacked the necessary tools to do either job thoroughly. But with their remarkable efficiency, and a considerable display of resourcefulness, they have been able to obtain high utilization from available equipment, and at the same time institute numerous service improvements calculated to please railway patrons.

New express freight trains—like the "Sakae" between Tokyo and the "Kitaschi" between Tyoma and Osaka—have cut running times by as much as 40% to 50%. Special trains for the exclusive movement of palletized goods and perishables have been introduced. A new all-container train—120 containers loaded into 24 freight cars —now covers the 550 km between Tokyo and Osaka in 11 hours.

Innovations like these have been limited by a shortage of new and efficient rolling stock and motive power. In 1953, JNR's motive-power roster of 5486 units

CONTINUED

Le Japon face à la prospérité économique

Les Chemins de fer japonais, auxquels le trafic pose de sérieux problèmes, ont commencé un vaste programme d'agrandissement et de modernisation représentant une somme de 1000 milliards de yen, somme que les économistes considèrent comme appropriée pour combler la lacune qui existe entre les possibilités et les besoins de transport et qui met en danger l'essor économique du pays. Le programme quinquennal dont les Chemins de fer de l'État japonais ont entrepris l'exécution le 1er avril 1961 prévoit pour l'équipement et la modernisation des dépenses annuelles de 200 milliards de yen, soit le double de ce qui est normalement employé. Le réseau, qui comprend 20.000 km, va augmenter de milliers d'unité le nombre de ses wagons, aujourd'hui de 113.000, remplacer par des machines diesel les 4321 locomotives à vapeur qu'il possèdait encore en 1960 et électrifier 22% de ses lignes. Les treize principaux chemins de fer privés du Japon ont passé d'un programme quinquennal à un programme triennal, triplé le montant des dépenses et porté l'ensemble de leurs investissements pour des installations et du matériel nouveaux à 133,5 milliards de yen, ou 44,5 milliards de yen par an. A eux seuls, les Chemins de fer de l'État consacrent 50 milliards de yen à du matériel roulant neuf.

Japan begegnet der Hochkonjunktur

Japans Eisenbahnen, die grossen Verkehrsproblemen gegenüberstehen, haben mit einem weitreichenden Ausbau- und Modernisierungsprogramm begonnen. Der dafür vorgeschlagene Kostenaufwand von 1000 Milliarden Yen wird von Volkswirtschaftlern als angemessen betrachtet, wenn dadurch die zwischen Transportvermögen und Transportbedürfnis bestehende Lücke, die die Hochkonjunktur des Landes gefährdet, geschlossen wird. Das neue am 1. April 1961 begonnene Fünfjahresprogramm der Japanischen Staatseisenbahnen (JNR), deren Netz 20.000 km umfasst, sieht für Ausrüstung und Modernisierung jährliche Aufwendungen von 200 Milliarden Yen vor, oder das Doppelte der normalen Ausgabenquote. Die gegenwärtigen 113.000 Güterwagen sollen um Tausende neuer Einheiten vermehrt, die 4321 in 1960 noch vorhandenen Dampflokomotiven durch Diesels ersetzt und die Eisenbahnstrecken zu 22% elektrifiziert werden. Die 13 hauptsächlichsten Privatbahnen Japans haben ihre Fünfjahrespläne durch Dreijahresprogramme ersetzt, die Aufwendungen pro Zeitraum verdreifacht und Gesamtinvestierungen für neue Anlagen und Ausrüstungen von 133,5 Milliarden Yen, oder 44,5 Milliarden pro Jahr, vorgesehen. Die JNR allein verwenden 50 Milliarden für neues Rollmaterial.

Nuevos proyectos de expansión en el Japón

Los ferrocarriles japoneses que se encuentran con un inmenso problema de tráfico, han abordado un gigantesco programa de modernización y expansión. Costará más de 1.000.000.000.000 de yenes precio razonable según los economistas, si puede llenar el vacío entre la oferta y la demanda de transporte, el que amenaza a retardar el desarollo de la economía nacional. Bajo el nuevo plan quinquenal que se inició el primero de abril 1961, los FC nacionales japoneses, que explotan 20.000 km., invertirán 200 mil millones de yenes anuales para equipos nuevos y modernización de las instalaciones, lo que representa el doble de las inversiones normales. Unos miles de carros de mercancías se añadirán al material móvil actual (113.000 carros). Locomotoras Diesel sustituirán a la mayor parte de los 4321 locomotoras de vapor y se electrificará el 22% de la red. Los 13 principales ferrocarriles privados substituirán a un viejo plan quinquenal con un programa de tres años que triplica las inversiones. La inversión privada total en instalaciones y equipos nuevos ascenderá a 133,5 mil millones de yenes, sea 44,5 mil millones de yenes anuales. Solamente en 1961 los FC Nacionales del Japon invertirán 50 mil millones de yenes en nuevo material móvil.

New de-luxe "Zoom" cars, operating on the limited express service of Nankai Railway Co., make up some of the better equipped trains on Japan's railways

New "Zoom" train-sets consist of four cars equipped with a motor, wide windows, reclining seats, automatic doors, air sprung bogies and cooling units

Important addition to JNR rolling stock was the AC/DC dual service electric railcars which made their debut on the Joban main line earlier in the year

JAPAN CONTINUED

included 5035 steam locomotives, 448 electrics and three diesels. By 1960 the total locomotive fleet was down to 5292 units. The number of electric units had risen to 778 and the number of diesels to 193, but 4321 steam locomotives were still in service. The freight-car picture has been no brighter. In 1953, JNR operated 106,732 cars; by 1960 the total had risen only to 112,971. (The private railways actually experienced a decline in freight-car ownership during the same period—from 10,600 units to 9,600. The principal importance of the private carriers, however, lies in the passenger field; they handle only 2% of the nation's total railway freight-ton-kms).

On the passenger side the rolling-stock situation has been somewhat better.

Multiple-unit electric rail cars have gone into service at a steadily increasing rate: JNR operated 2762 such units in 1953; 3256 in 1956, and 4170 in 1960.

On 1 June, a new multiple-unit electric railcar set—the "Phoenix"—made its debut on the mainline of the Nagoya Railway which links Toyohashi, Nagoya and Gifu, and three of the six-car train-sets, built by Nihon Sharyo, Ltd., are now in service. (The name "Phoenix" was chosen as a symbol of everlasting prosperity for the railway). The trainsets feature "panoramic" observation cars at each end, somewhat similar to the Italian ETR 250. The cars seat 62 to 66 persons, and are equipped with buffers of 250-ton shock absorbing capacity.

Three new electric expresses—the "Naniwa", "Settsu" and "Kinsei"—are also in service between Tokyo and Osaka. Each of the trains, which consists of 12 railcars, features two dining cars.

Work is also in progress on the design of six prototype electric railcars for the new Tokaido line. These are scheduled to be completed next March.

In non-electrified territory, the trend has been toward diesel rail cars (p. 32, IRJ, Aug./Sept.). Only 453 were in service in 1953. By last year this number had grown to 1790. JNR's standard-coach fleet included 11,596 units in 1953, 11,388 in 1956 and 11,537 in 1960. Private railways operated 12,700 passenger cars of various types in 1960, compared with 10,800 in 1953. New passenger cars are of all-metal, light-weight construction; in express service they are air-conditioned.

A recent innovation was the installation of an electronic seat-reservation system in Tokyo. Eventually, JNR plans to install similar systems in all of its major reservation offices.

Another innovation which has proved popular with the public is the "Tatami"—

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10/61

Five-Year-Plan

Japanese National Railways
(Unit: 100 million yen)

Tokaido line	173.5
Improvements	255.6
[illegible]trification	133.0
[illegible]elization	58.8
[illegible]lling stock	249.4
[illegible]mmuter facilities	64.0
[illegible]rhead	40.7
[illegible]AL	975.0

Three-Year-Plan

13 Private Railways
(Unit: 100 million yen)

Rolling stock	31.9
Track facilities	24.0
Electrical facilities	16.8
Structures	20.1
New lines	33.3
Overhead	7.4
TOTAL	133.5

Japan's Traffic Outlook for 1970

Traffic	JFY 1958	1970	% of increase	% to total in 1970
Freight:	(Unit: 100 million ton/km)			
JNR	453	815	180	37.5
Motor trucks	130	498	382	22.9
Coastal vessels	392	860	219	39.6
Total	975	2,173	223	100.0
Passengers:	(Unit: 100 million passenger/km)			
JNR	1,062	2,039	192	40.1
Private railways	534	981	183	19.3
Total railways	1,596	3,020	189	59.4
Busses	437	1,445	331	28.4
Sedans	63	504	800	10.0
Total, motor carriers	500	1,949	390	38.4
Aircraft	4	103	2,507	2.0
Ferries	9	10	111	0.2
Total	2,109	5,082	241	100.0

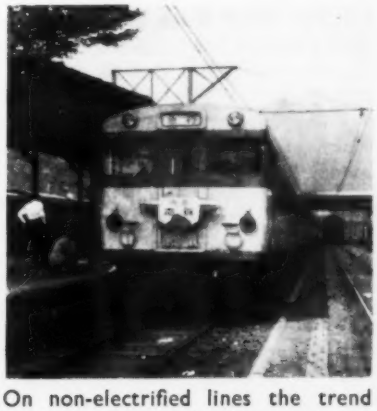
a rail car with a remodelled interior resembling a comfortable Japanese room. One car has been used for recreation trips in the Northeastern district, and JNR plans to add 10 more to its roster for services in rural areas.

JNR's major passenger problem is commutation—a service requiring sizeable fleets of equipment that stand idle for most of the working day. Commuters account for 65% of the total number of passengers carried by rail, but contribute only about one-fifth of total passenger revenues. The problem is most severe in Tokyo, whose 4,000,000 commuters account for 30% of JNR's total passenger load. (At one time early this year, Tokyo's commuter crush achieved such proportions that one station manager kept five pairs of sandals in reserve for commuters who lost their shoes during the rush hour.)

Serious attention is being given to monorail as one answer to Japan's commuter problem. Six companies have applied, or plan to apply, for licenses to operate nine monorail lines; since the Transport Council favors the idea, it is likely that several such lines will soon be in operation. A number of technical and investment agreements have already been concluded between Japanese and foreign manufacturers for monorail production. Lockheed Aircraft (US) has joined with Kawasaki Aircraft, Kawasaki Rolling Stock and five other Japanese companies in creating the Lockheed Monorail Company. The newly-created Nippon Airway Development Company (formed by Hawata and Fuji Steel Works, Toshiba Electric, Mitsubishi Heavy Industries, Kisha Seizo and several other companies) is entering into a monorail-production agreement with the Safege Corporation (France). Still another major railway supplier, Hatachi, has joined with the Alberg Corporation (West Germany) to

CONTINUED

One of three new electric expresses, the "Naniwa" is in service between Tokyo and Osaka. The train consists of 12 railcars; features two dining cars



On non-electrified lines the trend has been toward the diesel rail cars

JNR "Tatami" coach is modelled along the lines of a typical Japanese room

Japan's Toshiba monorail at Nara Park is first of many units being planned

Major Private Railways in Japan

Railway	Capital (Million yen)	Total Route kms Operated	Track Gauge in Meters
Tokyo-Yokohama area:			
Tobu R.R.	2,400	503	1.067
Seibu R.R.	1,049	151	1.067
Odakyu R.R.	1,900	111	1.067
Keisei R.R.	3,000	82	1.435
Keihin R.R.	1,800	72	1.435
Tokyo Kyuko R.R.	4,500	65	1.067 & 1.372
Keio Teito R.R.	2,000	59	1.067 & 1.372
Metropolitan Rapid Transit Corp.	10,100	36	1.435
Osaka-Nagoya area:			
Nagoya R.R.	4,050	504	1.067
Kinki Nippon R.R.	6,400	392	1.067 & 1.435
Nankai R.R.	2,400	151	1.067
Keihanshin R.R.	2,800	56	1.435
Fukuoka area:			
Nishinippon R.R.	2,025	133	1.067 & 1.435

Source: Ministry of Transportation

JAPAN CONTINUED

form the Hitachi Monorail Consultant Company.

As of this summer, the Ministry of Transportation had received seven applications for operation of monorail lines in Japan.

These include applications from:

- The Nagoya Railway Co. for construction of a 1.6-km line at a cost of 300 million yen ($830,500). Nagoya is also seeking permission to build a 43-km monorail from Gifu City to Yoro-no-Taki.
- The Nihon Koka Dentetsu for a 4-km monorail to connect Tokyo's business area with the Tokyo International Airport.
- The Hiroshima Monorail Kanko Kaisha, which plans to build a 1.4-km monorail in the Hijiyama Park.
- The Nippon Monorail Dentetsu Kaisha for a 20-km monorail connecting Otemachi and Mitaka.
- The Nippon Radiowave Tower Co., which wants to constructa 1.2-km line between Hamamatsu-cho station and the Tokyo Tower vicinity.
- The Hokkaido Real Estate Co., for construction of a 4-km line from Nikko Kirifuri to Kirifuri-no-Taki in the scenic Japanese National Park area.

Pioneer in this field is the Tokyo Shibaura Electric Co. Its new Toshiba supported-type monorail is of the amusement-park variety, but may serve as a prototype for more elaborate models in the future. The 850-m concrete monorail is laid in an 8 shape. The train itself, consisting of three stainless-steel articulated cars, can carry 88 passengers at speeds up to 40 km/h. Total length of the train is 31 m. Width of cars is 2.33 m; height 3 m. The train is equipped with 4 20-kw traction motors and high pressure pneumatic rubber tires. Electrical power is provided by a third-rail system built along-side the monorail. A spring supported body prevents vibration and shock, and safety is assured by a combination of tortion bar, coiled springs and rubber cushioning.

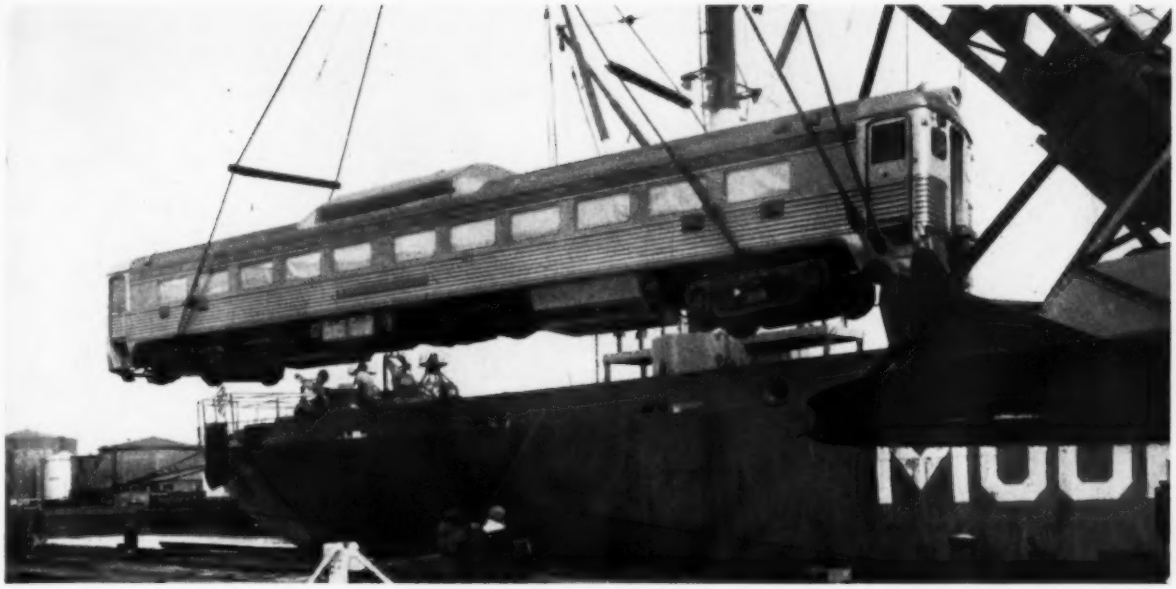
Lower real estate and construction costs of monorail are particularly appealing in crowded Japan. Construction costs for projects listed above are estimated at from 140 million yen ($390,000) to 690 million yen ($1,900,000) per kilometer, compared to average costs of 1700 million yen ($4,720,000) for subways and 400 million yen ($1,100,000) for overhead railways per kilometer.

While the railways will welcome any relief that monorail may offer in absorbing some of the present burden of commuter services, they are expecting no miracles; sizeable provisions have been made in present expansion plans for bigger and better commuter facilities.

Along with plans to expand the railways' capacity have come tariff measures that will help pay the bill. JNR's passenger fares were increased by an average of 14.6% and freight rates by 15% on 1 April of this year. The increases will bring JNR additional annual revenues of approximately 48.6 billion yen, or 12% of the total estimated revenue for the current fiscal year.

Some outside financing is in prospect. For example, an $80-million World Bank loan will pay about one-seventh of the cost of the new 500.5-km Tokaido Line between Tokyo and Osaka, the biggest single project scheduled for completion during JNR's five -year plan (p. 9, IRJ, June 1961).

The Tokaido Line, which JNR claims will provide the world's fastest rail service, is a show-case project in which Japanese railwaymen take considerable pride. Given a little time, and the necessary funds, they hope in time to make this kind of railroading the rule for all of Japan.



Brazil's Railways Order 149 New Cars

One hundred forty-nine new Budd-designed stainless steel passenger cars of various types will go into service on Brazilian railways this year and next. Their construction is covered by three separate orders on which work is now in progress or will begin shortly.

One of the orders, negotiated early in July by the Budd Company's International Division with the Brazilian Federal Railway System (Rêde Ferroviaria Federal S.A.), is for 23 self-propelled air-conditioned rail-diesel cars. These are to be built at the Red Lion plant of Budd's Railway Division in Philadelphia, Pennsylvania, USA, at a cost of more than $4,000,000 (US). Engineering work on these cars has started; construction will begin in October, and first deliveries will be made in mid-1962, with 13 cars being shipped from Philadelphia to Rio de Janeiro and 10 to Santos.

The second order covers 103 meter-gauge main-line cars being built by Budd's Brazilian licensee, MAFERSA. Bogie frames and disc brakes for these cars are being built by Budd in the United States, under another International Division contract, at cost in excess of $1,000,000. Shipments of the 206 brake and bogie units (103 car sets) will be completed this year. The cars themselves will be finished next year.

The third order, to be completed by MAFERSA this year, is for 23 broad-gauge main-line cars.

Four of the rail-diesel cars will be broad-gauge (1.6 meter or 5 ft. 3 in.) units, 25.9 meters (85 ft.) long, for operation on the Estrada de Ferro Central do Brazil. Two of these will be all-passenger coaches; the other two will be coaches with buffets.

The other 19 RDCs will be meter-gauge (3-ft. $3^3/_8$-in.) units, 18.7 meters ($61^1/_2$ ft.) in length, for use on various meter-gauge railways in the Brazilian states of Rio de Janeiro, Minas Gerais, Paraná, Santa Catarina, São Paulo, Rio Grande do Sul and Mato-Grosso. Eight of them will be passenger coaches with buffet sections and the other 11 will be all-passenger cars.

Purchase of all 23 cars is being financed under a credit authorized several years ago by the Export-Import Bank of Washington, D.C., USA.

The same Export-Import Bank credit is also financing the 103 meter-gauge cars which MAFERSA is building for the E.F. Sorocabana. Included in this lot are sleeping cars, coaches, lounge-coaches, dining-kitchen cars and luggage cars.

The 23 broad-gauge cars also being built by MAFERSA are of the Budd-developed Pioneer III type, fitted out as coaches, lounge-coaches and kitchen-diners. They will be operated on the E.F. Araraquara.

Brazilian railways currently own a total of 210 stainless steel cars built by Budd or under Budd license. Six of these are self-propelled rail-diesel units.

Voitures Budd pour le Brésil

Les Chemins de fer brésiliens mettront prochainement en service 149 voitures en acier inoxydable de différents types. Les unes seront construites aux Etats-Unis selon contrat passé avec le département international de la Budd Co, les autres sous licence au Brésil.

Budd-Personenwagen für Brasilien

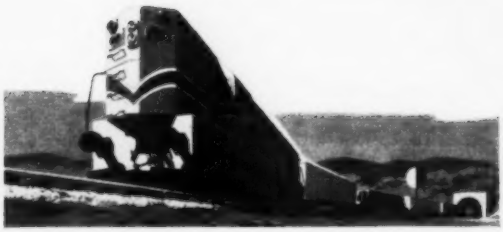
Die Brasilianischen Eisenbahnen setzen in nächster Zeit 149 neue, aus rostfreiem Stahl gebaute Personenwagen verschiedener Typen in Betrieb. Einige davon werden von der Internationalen Abteilung der Budd-Gesellschaft unter Kontrakt in Amerika und andere unter Lizenz nach Budd-Bauart in Brasilien gebaut.

Coches Budd para el Brasil

Los ferrocarriles brasileños pondrán en servicio dentro de poco 149 nuevos coches de acero inoxidable de diferentes tipos. Unos se construirán en los EE.UU. según contratos concertados con la Sección Internacional de la Casa Budd Co.; otros en el Brasil, según los diseños de Budd, como concesionarios de esta casa.

Cross-section of General Motors 567C two-cycle Diesel engine as built by production-line Methods at our La Grange, Illinois works. The GM 567 engine features: low combustion pressures; low speed (piston speed 1380 ft./min., rpm 835); unit injection (no high pressure fuel lines); floating pistons; major parts interchangeable in all engines; all components easily accessible.

MOTORS LOCOMOTIVES



lowest replacement parts costs in the industry

General Motors Diesel locomotives have an unequalled record for dependability and durability, with hundreds of units having accumulated *a million miles and more without major overhaul.*

But wearing parts in any Diesel-Electric locomotive need to be replaced at periodic intervals—and, in the case of General Motors locomotives, replacement parts prices are the lowest you'll find anywhere.

That's because these components are produced in volume on the same lines as new locomotive units—by advanced manufacturing methods which have no counterpart elsewhere in the industry.

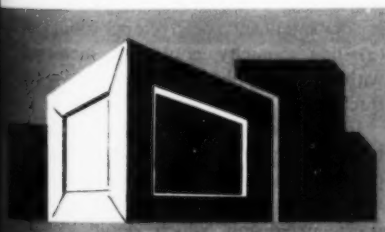
For example, a set of pistons for a GM 567 Diesel engine costs as much as 50 per cent *less* than pistons for another Diesel of comparable capacity—and GM 567 engine pistons frequently run more than 500,000 miles.

Moreover, GM locomotive parts are easily accessible—require less time to replace. A complete cylinder assembly of a 567 engine can be replaced by two men in less than one hour.

And because of high interchangeability, GM locomotives require the smallest parts inventory. The same piston fits all 567 engines from six to sixteen cylinders—and latest improvements in parts are made applicable to old units as well as new.

Ruggedly built to produce long mileage, GM locomotive parts weigh less than others—so shipping charges are lower. And all GM locomotive parts are scientifically packaged for protection both in shipment and in storage.

The *real* price of a Diesel locomotive is determined by what it costs to operate and maintain across its years of useful life. Actual service records of railways the world over prove that General Motors locomotives *cost less in the long run.*



General Motors locomotive parts are scientifically packaged in strong yet lightweight, readily stackable cartons for protection both in shipment and in storage.

GENERAL MOTORS OVERSEAS OPERATIONS

Division of General Motors Corporation, New York 19, N.Y., U.S.A.

Cable Address: Autoexport

ASSOCIATE BUILDERS: AUSTRALIA—The Clyde Engineering Co. Pty., Ltd., Sydney, N. S. W. BELGIUM—LaBrugeoise et Nivelles, St. Michel-lez-Bruges • GERMANY—Henschel Werke, GmbH, Kassel • SOUTH AFRICA—Union Carriage & Wagon Co. (Pty.) Ltd., Nigel, Transvaal SPAIN—Material y Construcciones, S. A., Barcelona • SWEDEN—Nydqvist & Holm Aktiebolag, Trollhattan

LOCOMOTIVE PLANTS: Electro-Motive Division of General Motors, La Grange, Illinois, U.S.A. General Motors Diesel Limited, London, Ontario, Canada

General Motors subsidiaries, branches or representation throughout the world

GM DIESEL POWER

GENERAL MOTORS LOCOMOTIVES

Modern tower at Nijmegen contains CTC controls in upper level and system coding and power equipment in lower

Netherlands Installs First CTC

The first centralized traffic control installation on the Netherlands Railways is now completed and in service between the cities of Nijmegen and Blerick.

This CTC-controlled territory parallels the Maas River and a portion of the western border of Germany. The railway traverses a productive agricultural region in which grain and stock raising are prominent and, in addition, gives access to the coal mining district to the south. Nijmegen's main industrial outputs are electrotechnical and chemical products, paper, and leather goods.

Traffic is exceedingly heavy on this 58-km rail line. Daily schedules provide for 38 passenger trains, 22 through freight trains, and 16 local freight trains. Passenger trains operate primarily during daylight hours while freight trains usually move at night.

The Nijmegen-Blerick installation marks the first use on any railway of the new high-speed, code-control system developed by the General Railway Signal Company. This system, with the copyright name of Quiktrol, consists of two interrelated parts: one part is for controls to effect changes in the position of wayside switches and signals; the other part is for indications to report changes to the operator as they occur in the signals, switches and train occupancy of track sections.

Interrelation between the two parts is such that control and indication transmission can occur simultaneously, and without interference between one field station and another. Indication transmission from more than one field location may occur simultaneously.

The controls consist of polar codes which are transmitted over a two-wire line circuit. The indications are created by keying carrier transmitters with an on-off code to transmit carrier frequency energy over the same pair of line wires. Each field location is assigned its own carrier frequency to enable the aforementioned simultaneous indication transmission.

The Netherlands Railways decided to install CTC for three important reasons: (1) existing station equipment needed replacement; (2) installation of automatic signals between stations would ensure greater safety and speed of operation, and (3) line capacity could be increased without the costly addition of any more trackage.

Four of the eight stations in the territory between Nijmegen and Blerick have passenger facilities. The control machine, located at Nijmegen, is designed for future expansion, which would include the control of four additional stations from Venlo to Roermond.

The control machine has a light green phenolic control panel with engraved white track lines (see photo). Colored indication lamps in the track lines show occupancy of sections by trains. Small signal symbols, located adjacent to the track lines, have colored indication lamps repeating signal indications occurring in the field.

Below the white track lines on the

control machine are signal levers which stand vertical on normal, and are turned right or left 90° to clear signals. Below these signal levers is a horizontal row of switch levers. Each lever stands vertical for switch normal and is turned 90° right for switch reverse. Whether a switch is locked or unlocked is shown by a lamp in the barrel of the switch lever.

Both the switch and signal levers are so placed on the panel as to be just beneath their respective switches and signals on the white track lines.

An automatic train recorder is built into the machine desk to record the movements of trains as they proceed through the CTC territory.

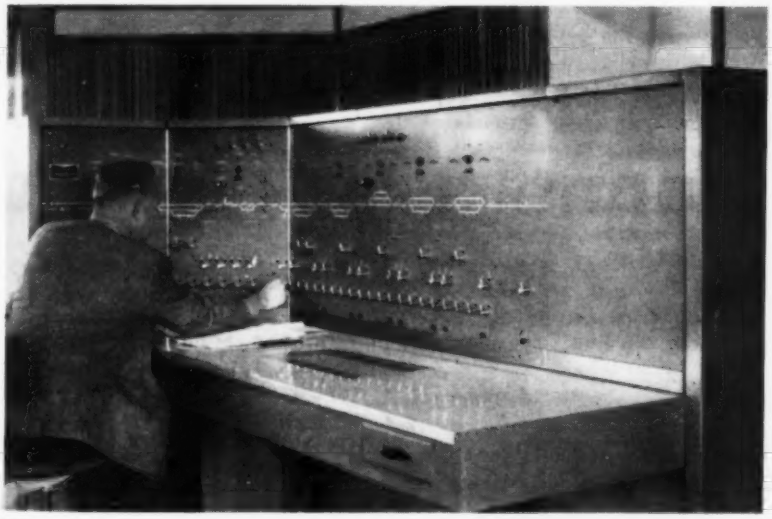
A total of 33 electric switch machines and 67 colorlight signals are controlled by this CTC system. The installation also includes 54 automatic block signals between sidings and several protected highway crossings.

Fifteen mechanical crossing gates have been replaced with automatic crossing protection. Two existing crossings were eliminated, and three crossings not previously protected are now equipped with automatic flashing lights. Thus, there are now a total of 21 protected crossings in the territory, eight equipped with automatic half-arm gates and 13 equipped with flashing lights.

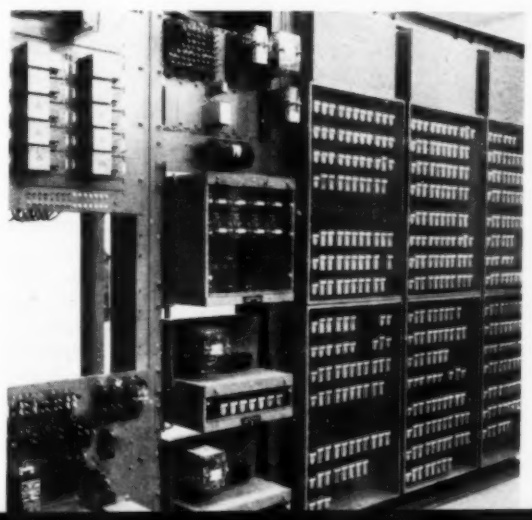
At stations, trains stop just short of pedestrian crossings. The short-arm gates lower automatically as trains approach. When a train is in the station and the crossing is clear, the gates can be raised by pushbutton operation.

The control machine, coding relays, gate mechanisms and carrier equipment were manufactured by the GRS Company. Plug-in safety relays of GRS design were manufactured in the Netherlands itself.

Equipment for a second CTC installation, between Utrecht and Amersfoort, has been ordered from GRS since completion of the Nijmegen-Blerick project. The new equipment will enable the railway to handle as many as 363 trains per day (p. 17, IRJ, July, 1961).



The control machine has a light green phenolic control panel with engraved white track lines. Colored indication lamps show occupancy of sections by trains on track lines and small signal symbols are adjacent to track lines.



GRS Quicktrol system consists of two interrelated parts; one for controls and one for indications. The equipment includes transistor carrier unit for the multi channel system of indication

Première télécommande de ligne en Hollande

Les Chemins de fer de l'État néerlandais viennent de mettre en service, entre Nimègue et Blerick, leur première installation centralisée de contrôle de la circulation des trains. Ainsi se trouve appliqué pour la première fois le système codé de télécommande rapide conçu par la General Railway Signal Company aux États-Unis. Il s'agit de deux appareils interdépendants; l'un commande aiguilles et signaux, l'autre indique la position des aiguilles et des signaux, ainsi que l'occupation des voies. Malgré l'interdépendance, commande et indication se font en même temps, sans causer de dérangements entre les différentes gares.

Hollands erste Streckenfernsteuerung

Die erste Streckenfernsteuerungsanlage der Niederländischen Eisenbahnen steht nun zwischen Nimwegen und Blerick im Betrieb, wobei erstmals das von der General Railway Signal Company in USA entwickelte Schnellsteuerungs-Kodesystem zur Anwendung gelangt. Das System besteht aus zwei in Abhängigkeit stehenden Aggregaten, von denen eines Weichen und Signale steuert und das andere die Weichen- und Signalstellung sowie die Gleisbelegung anzeigt. Trotz der Abhängigkeit erfolgt Steuerung und Anzeige gleichzeitig, ohne Störungen zwischen verschiedenen Stationen zu verursachen.

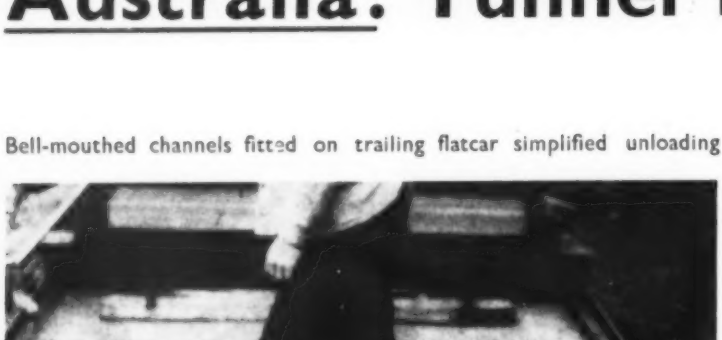
La Holanda adopta el primer CTC

Se ha terminado y ya está en servicio entre Nijmegen y Blerick el primer control centralizado de tráfico de los ferrocarriles holandeses. Se ha aplicado por primera vez el nuevo sistema de control de códigos a alta velocidad desarrollado por la General Railway Signal Company (US). Consiste en dos partes interdependientes. La una controla la posición de los desviadores y de las señales, la otra indica los cambios en las señales, los desviadores y el estado de ocupación de las secciones de vía. La interdependencia es tal que la transmisión de los controles y de las indicaciones pueden ocurrir simultáneamente sin producir interferencia entre las estaciones de campo.

Gap between rail length is being closed with wire puller to give correct spacing for application of Thermit welding

Australia: Tunnel Track Relaid

Bell-mouthed channels fitted on trailing flatcar simplified unloading



The New South Wales Government Railways has recently completed the relaying of tracks in Australia's longest tunnel, at Woy Woy (66 km from Sydney). The application of Thermit jointing to flashbutt welded lengths now gives a continuous rail for the whole of the tunnel's 1768-m bore.

This tunnel is located on the NSWGR's busy duplicated main northern line and is a vital traffic artery to the State's highly productive northern regions. The line was electrified in January, 1960 at 1500 v. DC with overhead conductors. Motive power is provided mostly by the system's 3820 hp Co-Co Metro-Vick built electric locomotives, though some trains are hauled by Australian-built diesel-electric locomotives of either General Motors or American Locomotive Company design in the 1600 to 1800 hp range.

The heavy passenger traffic is worked by either locomotive-hauled luxury air-conditioned expresses or else stainless steel multiple-unit electric trains which provide commuter services for areas up to 113 km from Sydney.

Formerly, the track in the tunnel, which is on a 1 in 107 grade, comprised 48.5-kg rail welded into 109.7-m sections with mechanical joints between each length and it was found that the corrosive content of the steam exhaust had a harmful effect on the track giving it an extremely short life and necessitating frequent relays.

Following the introduction of electric traction and the elimination of this corrosion, it was decided to relay completely the tunnel and replace the mechanical joints with Thermit welds to give a continuous rail between portals. This was made possible by the absence of insulated joints within the tunnel.

The decision to Thermit-weld on site meant that the 109.7-m lengths could be made up at the railway's flashbutt welding depot with undrilled rails. This increased the strength of the installation and will eliminate any later tendency for cracks to develop around the bolt holes.

Restricted clearances within the tunnel and at its approaches made impracticable the normal method of unloading welded rails over the sides of the flatcars in the rail train and considerable investigation was undertaken into methods of overcoming this problem. The branch's welded rail engineering staff considered that end-unloading would be the best way of handling rails at this location and formal approval was granted by the traffic branch for the operation of works trains without a brake van at the rear.

The trailing vehicle of the welded rail flatcar set was fitted with specially fabricated channels and skids at one end to facilitate unloading.

Two bell-mouthed channels were fitted with vertical guide rollers at the narrowest part. The channels were curved over the end platform and extended down to the lower edge of the automatic coupler. Skid plates were also fitted to the first and second bolsters to ease the movement of the rails off the vehicle.

The rails were loaded onto the train at the welding depot in a single tier of 14 lengths giving seven 109.7-m sections for each rail. Considerable care was taken in loading the train so that the first length to be unloaded was located opposite the middle of the channelling. Special clips were also fitted to the end of each length to assist in unloading.

On arrival at the rerailing location, the end buffer truck and guard's van were detached and left well clear of the work area. Wire ropes 21.3 m in length with hooks on each end, were then connected to the clips on the end of the first rail length and special anchors which had previously been clamped to the foot of the

CONTINUED

Changement de rails dans un tunnel en Australie

Le gouvernement de la Nouvelle Galle du Sud vient de terminer la transformation d'une voie dans le plus long tunnel d'Australie, sis à Woy Woy, à 66 km de Sydney. Les rails, soudés par le procédé de l'étincelage, sont joints dans le tunnel à la soudure thermique, de sorte que l'on a une voie sans joint sur toute la longueur de la galerie (1768 m). Celle-ci se trouve sur la ligne à double voie et à grand trafic du Nord, qui constitue une artère vitale pour cette région productive du pays.

La voie du tunnel, d'une déclivité de 9,33‰, était faite de rails de 33 m 23 et d'un poids de 48,5 kg au mètre courant, lesquels subissaient une forte corrosion due à la traction à vapeur et devaient être fréquemment changés. Après l'introduction de la traction électrique, en 1960, on a reposé toute la voie du tunnel; ne comportant aucune section de rails isolés, celle-ci est sans joint d'un bout à l'autre. Comme le profil du tunnel et ses accès ne permettaient pas le déchargement de longues barres sur le côté, cette opération se fit par l'arrière du train. Pour cela, on avait renoncé au wagon-frein de queue, réglementaire dans les trains de service.

Gleisverlegung in einem Tunnel Australiens

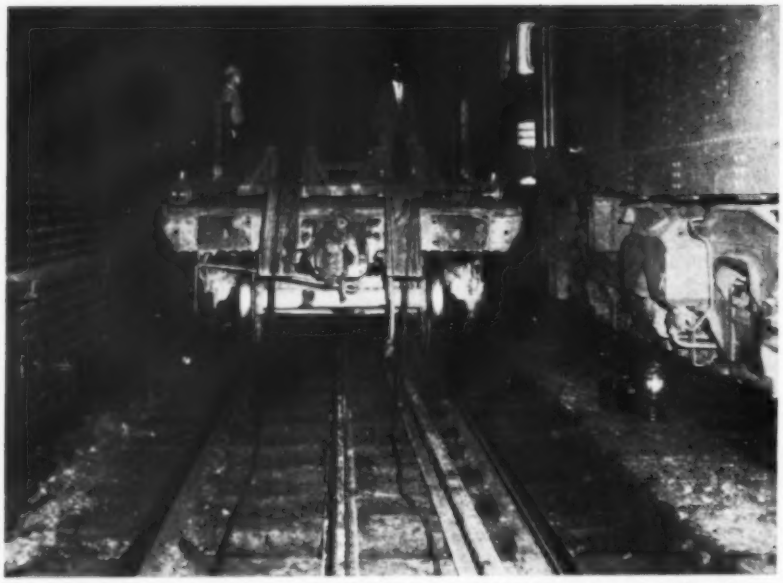
Die Regierung von New South Wales beendigte vor kurzem die Gleisverlegung in Australiens längstem Tunnel, das sich im 66 km von Sydney entfernten Woy Woy befindet. Nach dem Abbrennstumpfverfahren zusammengeschweisste Schienenlängen wurden im Tunnel durch Thermitschweissung verbunden, so dass dieses nun, auf seiner ganzen Länge von 1768 m, lückenlos verschweisste Schienen aufweist. Das Tunnel gehört zu der doppelspurigen, verkehrsreichen Nordlinie, die eine lebenswichtige Verbindung nach dem produktiven Norden des Staates darstellt.

Das Tunnelgleis, das eine Neigung von 9,33‰ aufweist, bestand früher aus Schienenlängen von 33,23 m mit einem Gewicht von 48,5 kg pro m. Diese Schienen hatten jedoch, bei der durch den Dampfbetrieb erzeugten Korrosion, nur eine kurze Lebensdauer gehabt und mussten oft erneuert werden. Nach der im Jahre 1960 eingeführten elektrischen Zugförderung wurde dann das ganze Tunnelgleis, das keine isolierten Gleisabschnitte aufweist, neu verlegt und lückenlos verschweisst. Da aber das Lichtraumprofil des Tunnels und seiner Zufahrten das Entladen von grösseren Schienenlängen über die Seite der Wagen nicht erlaubte, wurde auf den üblichen Schlussbremswagen der Dienstzüge verzichtet, und der Entlad erfolgte über das Ende des Zuges.

Renovación de la vía en un Túnel australiano

El Gobierno de Nueva Gales del Sur acaba de terminar la renovación de la vía en el túnel más largo de Australia, cerca de Woy Woy (66 km de Sydney). La aplicación de la soldadura aluminotérmica a tramos soldados a tope resulta en rieles continuos para todo el túnel. Este túnel está situado en la línea de doble vía septentrional del Ferrocarril y es un arteria vital para las regiones muy productivos en el norte del Estado.

La vía anterior del túnel (pendiente 1 en 107), constaba de rieles de 48.5 kg soldados en tramos 109.7 con juntas mecánicas entre cada tramo. Se averiguó que el contenido corrosivo del vapor de escape tenía un efecto dañoso en la vía resultante en renovaciones frecuentes. A raíz de la introducción de tracción eléctrica en enero 1960, se decidió renovar completamente el túnel y sustituir las juntas mecánicas por soldaduras aluminotérmicas para obtener rieles continuos entre los portales lo que permitía la ausencia de juntas aislantes dentro del túnel. Por ser el gálibo dentro del túnel y en los accesos pequeño, el método normal de descargar tramos soldados por los laterales de los vagones plataforma era infactible. Los ingenieros llegaron a la decisión de que la carga por el testero era la mejor manera y se consintió la operación de trenes de trabajo sin furgón de cola.



Wire ropes 21.3 m long were connected to the rail lengths lying on the flatcar, which was specially constructed to overcome the tunnel clearance problems

As the railcar moved forward, slings took the strain and rail lengths were simultaneously hauled off the train and dropped into the four-foot to await welding

rail, 21.3 m in advance of the position where the first length was to be cut in.

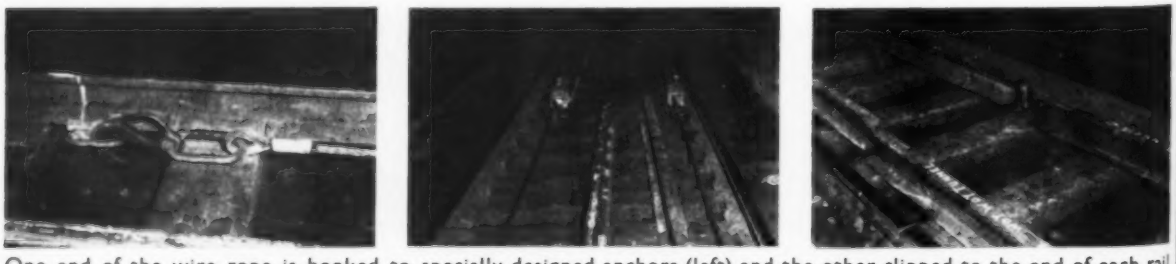
As the rail train was moved slowly forward, the slings took up the strain and the first 109.7-m lengths were simultaneously hauled off the train and dropped into the four-foot. Each pair of rails was unloaded individually and three sets of ropes were used recurringly.

A "Tirfor" wire rope puller with a capacity of five tons was used to position the rails longitudinally to give the correct gap for Thermit Quick-Welding, which was carried out while the new lengths were lying in the four-foot before being laid in position. This gave a continuous rail 768 m in length and three such sections were required to make up the full length of the tunnel in addition to the approaches.

When occupancy was obtained for the actual rerailing process, the old length was cut at one end and unfished at the other. The old rail was unspiked and lifted into the four-foot and the new rail was lifted over the old and spiked into position.

Cutting out of the old sections on both rails and their replacement with the new welded lengths was carried out between 10.00 and 14.30 hours on three successive days, although several days were necessary between each relay for the train to be returned to the welding depot at Chullora, reloaded and relocated at the start of the next drop. Specially designed clamps were used to hold the undrilled ends of the 768-m lengths together under the heavy traffic on this line and these, together with the joints at the extremities of the relay were later Thermit Quick-Welded to give a continuous length throughout.

Both tracks in the tunnel have now been relaid by the procedure outlined above and it is confidently expected that the installation will require little or no maintenance for a good many years to come.



One end of the wire rope is hooked to specially designed anchors (left) and the other clipped to the end of each rail length (center). Finally each newly unloaded pair of 109.7-m lengths is placed end to end with previous lengths (right)

claim its sponsors, cut rail travel time between the two cities from the present 95 minutes to 35 minutes. The Israeli Railways, which has expressed doubts about the project, has its own plan to shorten the existing line by 14 km and cut travel time to 55 or 60 minutes.

ITALY: The Italian Cabinet has agreed to a recommendation of the Minister of Transport that a total of 800 billion lire should be spent on FS modernization. The first part of the investment plan would cover a three-year period and would involve the expenditure of 500 billion lire. The railways have asked parliament to permit the abandonment of 1,600 km of uneconomic lines and to aprove increases in tariffs.

JAPAN: Engineers have successfully completed boring through the 13.8-km Hokuriku tunnel. The tunnel, which is Japan's longest, connects Tsuruga and Imasho on JNR's Hokuriku trunk line and is scheduled to be opened for traffic in April, 1962. Some 2.5 million persons have worked on the project which will cost an estimated 7.1 million yen. The new tunnel will cut transit time between the two cities by 24 minutes.

... Extensive field tests using a cobalt-60 radioactive device to activate railway crossing warning signals are being conducted by Tokyo Express Electric Railways on its Mekama line. A steel tube containing a cobalt-60 charge with a discharge of one milli-curie is placed under the coach. A pick-up device placed between the rails about 100 meters in front of the railway crossing detects the radio-active discharge and activates the warning signal.

MALI: USSR technicians have arrived in this African republic to begin preliminary surveys of a new line between Mali and Guinea. An IL 14 Soviet aircraft has also been sent to Mali for use in mapping the route of the railway from the air. The line will link Bamako, the capital of Mali, with the existing Guinean Railway which runs to Conakry on the Atlantic.

NORWAY: Revenues of the Norwegian State Railways increased 11% in 1960, while expenses rose only 1%. The system's deficit, however, still amounts to 30% of total revenues. Carloadings increased 7.3%. Steam motive power handled 26% of total freight train km and 5% of passenger train km.

SOVIET UNION: The Russian locomotive works at Lugansk reports that trials of a new 6,000-hp gas-turbine locomotive have been completed. At the locomotive plant at Tiflis, trials of a new T8 electrical unit have begun. The unit is eight tons lighter than the N8 locomotive currently in serial production at Tiflis, and has a maximum speed of 100 km/h.

... Freight cars with adjustable axles for use on broad or standard gauge tracks are reported to be in use on Soviet Railways. A train of tank cars equipped with the axles was hauled from Kuibyshev to the Leuna works in East Germany this summer. The 6,275-km trip took 12 days instead of the usual 24. Soviet passenger cars used in international services may be fitted with similar axles.

... Following reports that automation experiments were being conducted on the underground systems of Kiev and Leningrad (p. 32, IRJ, July), the USSR now reports that initial tests of a remotely-controlled underground train have been successfully carried out in Moscow.

SWEDEN: Piggyback service (an adapted Clejan system) has been inaugurated between Stockholm, Goteborg, Malmo and Halsingborg.

... The line between the iron ore fields at Kiruna and the Norwegian port of Narvik is currently being relaid to increase capacity. When the work is completed in 1964, the line will accommodate 25-ton axle loads as compared with 18 tons at present. The project includes the rebuilding of 60 bridges.

... The last of eight 3600-hp locomotives ordered by the Swedish State Railways has been delivered by Nohab, Trollhättan. The 62-ton locomotives have a maximum speed of 150 km/h. Built in close collaboration with Asea, AB Svenska Järnvägsverkstäderna (ASJ) and Motala Verkstad, the units are similar to the two delivered to the SSR for testing in 1955.

UNITED STATES: The Interstate Commerce Commission has recommended that the federal government subsidize passenger-carrying railroads. The proposal followed the ICC's inquiry into the financial difficulties of the New York, New Haven & Hartford Railroad, which went into reorganization under the bankruptcy laws this past July. During the first six months of 1961, the net profit for all US Class I railroads was $60 million, compared to $238 million during the first half of 1960 and $307 million for the first half of 1959.

WEST GERMANY: Between June, 1960 and June, 1961, the German Federal Railways reduced its steam locomotive fleet from 7,513 units to 6,998 units. During the same period the number of electric locomotives increased from 955 to 1,065, and diesels from 875 to 1,010. DB expects to replace all of its steam power by 1976.

... The private railway Kleinbahn AG Kiel-Segeberg, of Kiel, will cease rail operations as from 2 December 1961. Main reason is the construction of a parallel highway which has attracted traffic from the rail carrier.

Europe Sets U Cli

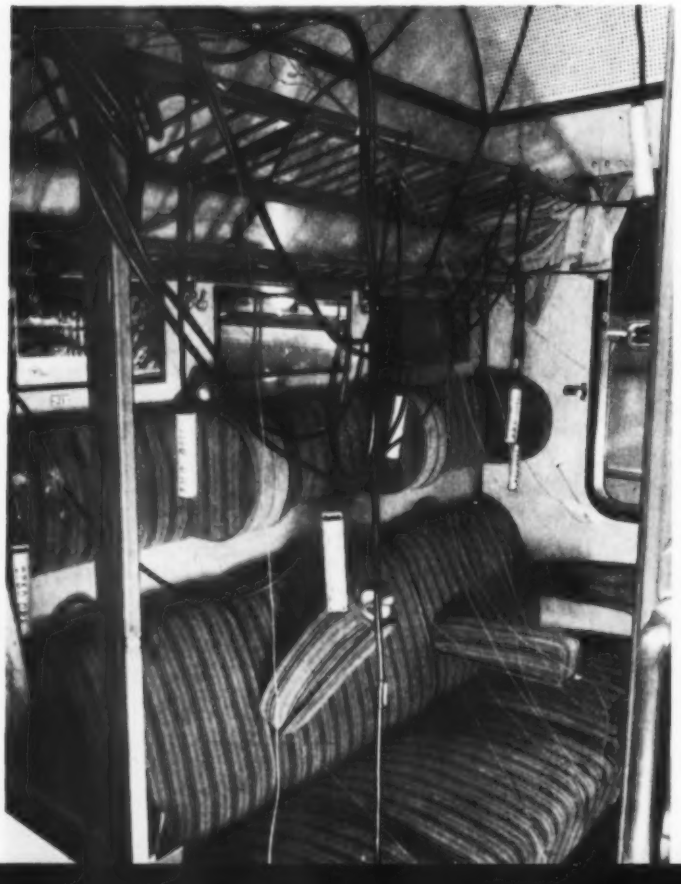
A new climatic research center in Vienna will help European railways solve the "hot and cold" question. The laboratory—claimed as the world's first—was set up to study the behaviour of rolling stock under varying temperatures and will subsequently lead, the European networks hope, to higher comfort standards and improvements in those services affected by extreme climatic conditions.

In cooperation with the Austrian Government the center was built in three years and financed from the pockets of Austrian, Belgian, British, Dutch, French, West German, Yugoslavian, Swedish, and Swiss Railways, Wagons Lits, Deutsche Schlafwagengesellschaft and the Austrian Government. It will be operated by the Austrian State Research Institute in conjunction with ORE, UIC's operating and research organization.

Major fields of study will include heating, ventilation and air conditioning

Behavior of wire cables is studied under freezing conditions

Interior of a German Federal coach rigged with recording gear



Coaches are tested in all temperatures

Climatic Research Center

problems, with emphasis on passenger coaches and multiple unit trains. Behaviour of diesel locomotives and refrigerated cars is also listed for investigation. "Possibles" for future attention include: permanent way in low temperatures and extreme dampness, dampened springs in varying temperatures, the influence of snowstorms on locomotives and rolling stock, and starting resistance in cold weather.

The center has two climatic-controlled rooms built for maximum size vehicles. One is destined for stationary testing and the other for simulated running.

Experiments in the stationary room are designed to study freeze-proof materials, loss of warmth through coach walls, time needed and current consumption for preheating coaches, behaviour of precooled refrigerated cars, action of the water tanks in stationary coaches, and efficiency of heating and air conditioning.

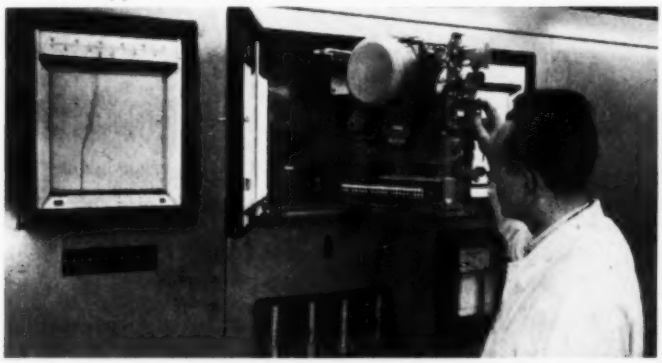
All tests can be carried out in a temperature range from –40° C to +50° C. At temperatures above +15° C, when cooling becomes necessary, the water content in the air can be regulated. In this manner every climate—from polar to tropical jungle—can be created by "push-button" control.

For tests under running conditions, a 540-hp motor produces windspeeds up to 120 km per hour. Top windspeed can be combined with a temperature of –15° C. At lower speeds, lower temperatures can be reached. Sunrays are simulated by special heaters.

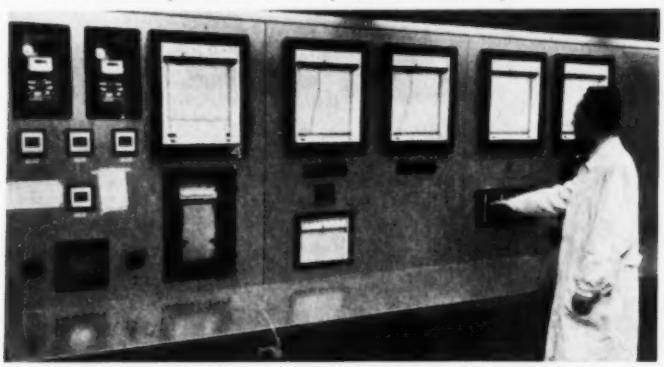
Both rooms are fitted with all the overhead voltages used in Europe.

The central control room receives such data as temperature, windspeed, air-dampness, energy and steam consumption. A combined telephone/alarm installation is used for communication with personnel in test rooms and visual contact is maintained through windows in the test rooms.

Sensitive apparatus in the central control room . . .



. . . records temperature, wind-speed and air-dampness



Station de climatisation

Cette nouvelle station s'efforce de résoudre les problèmes que posent les conditions atmosphériques aux chemins de fer européens; elle étudie, en particulier, les effets de diverses températures sur le matériel roulant. Construite en collaboration avec le gouvernement autrichien et financée par les chemins de fer allemands de l'Ouest, autrichiens, belges, britanniques, français, suédois, suisses et yougoslaves, les compagnies de wagons-lits internationale et allemande, de même que par le gouvernement autrichien, elle est exploitée par l'office de recherches des Chemins de fer fédéraux autrichiens, d'entente avec l'ORE/UIC.

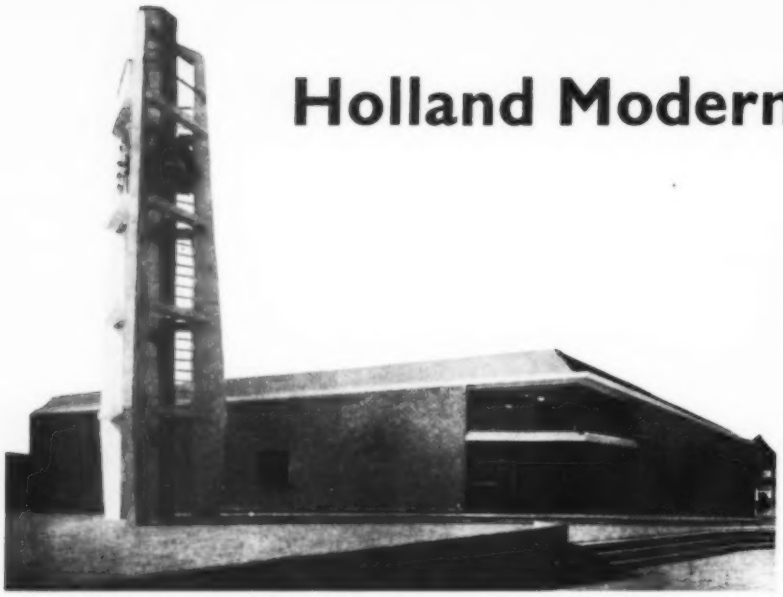
Klimaforschungszentrale Wien

Diese neue Zentrale behandelt Probleme, die den europäischen Eisenbahnen durch Witterungseinflüsse erwachsen und prüft u.a., wie sich verschiedene Temperaturen auf das Rollmaterial auswirken. Erbaut in Zusammenarbeit mit der österreichischen Regierung und finanziert von den österreichischen, belgischen, britischen, niederländischen, französischen, westdeutschen, jugoslawischen, schwedischen und schweizerischen Bahnen, der Internationalen und der Deutschen Schlafwagengesellschaft sowie der österreichischen Regierung, wird die neue Forschungsstätte vom Forschungsamt der Oesterreichischen Bundesbahnen im Einvernehmen mit dem ORE/UIC betrieben werden.

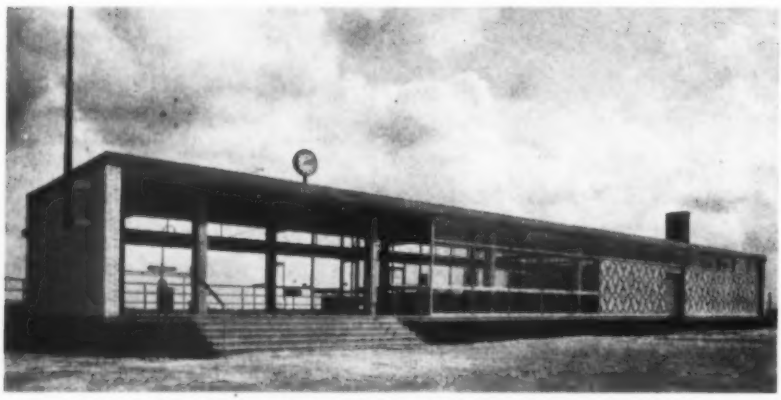
Centro de Investigaciones

Un nuevo centro de investigaciones en Viena ayudará a los ferrocarriles europeos a resolver los problemas que plantea la operación bajo cambiantes condiciones climatológicas. Fué establecido el laboratorio—se dice el primero del mundo—con el fin de estudiar la operación de equipo móvil bajo temperaturas diferentes. Se construyó el centro en tres años en cooperación con el gobierno austríaco y fué financiado por los ferrocarriles austríacos, belgas, británicos, franceses, holandeses, de Alemania occidental, de Yugoeslavia, Suecia y Suiza, la Deutsche Schlafwagengesellschaft y el Gobierno austríaco. Será dirigido por el Instituto de Investigaciones del Estado austríaco en cooperación con la organización de operación y investigación ORE/UIC.

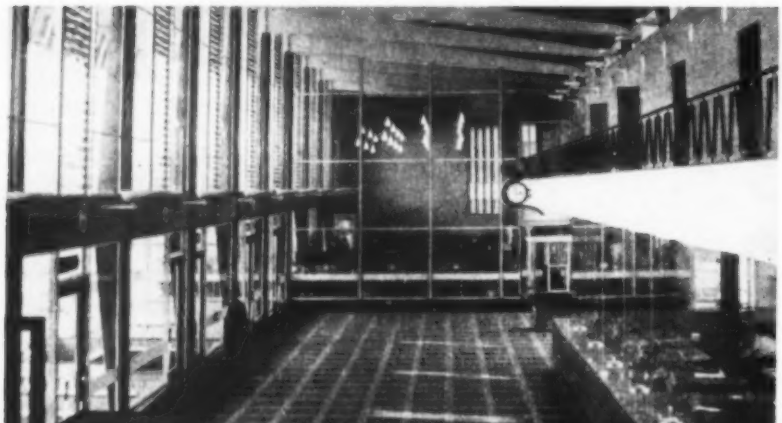
Holland Modernizes Stations



The clock tower at Den Helder is not only an efficient and good looking time-piece, but it also hides a large chimney from view



After complete demolition of the old station at Purmerend, the new structure was re-designed to meet present day requirements



Interior of main hall at Venlo, showing entrance doors on the left, ticket office to the right and first floor gallery above

Since the end of World War II, the Netherlands Railways (Nederlandsche Spoorwegen) have modernized nearly all their passenger stations. Some 35 have been completely rebuilt and many more have had extensive alterations.

War damage provided some opportunities for the construction of integrated transport centers; incorporating railway station, local and inter-urban bus terminals, car park, cycle store and taxi rank. This has also enabled some elimination of level crossings in the immediate vicinity.

Standardization has been restricted—except in the case of smaller stations—for it has been realized that technical and traffic development demands flexible design. This does not mean, however, that standardized components have not been used whenever possible.

Here are some examples of recent design.

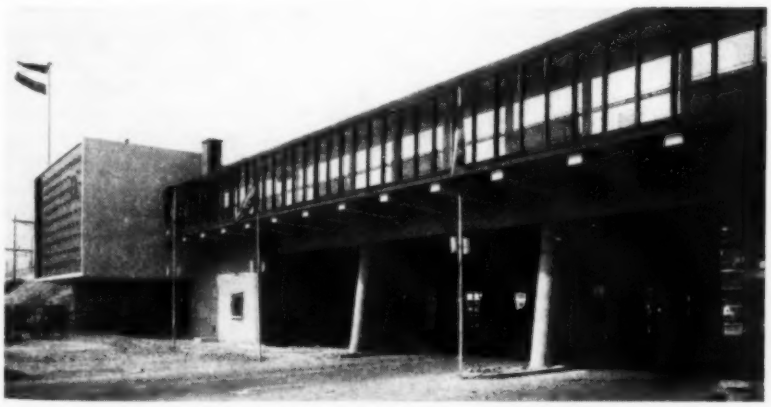
Purmerend — *Architect Ir. K. F. G. Spruit b.i.* — A small building, designed by an outside architect. Essentially a commuter station, the previous building was far too large for present day traffic requirements. The old station was completely demolished and the new structure built with matching interior and exterior. There is an entrance leading into the waiting room which has fully glazed walls.

Venlo — *Architect Ir. K. van der Gaast b.i. and W. J. Drees* — A combination of junction and frontier station. Accommodation has, therefore, been provided for passengers traveling in the Netherlands and those into and out of Germany. The basic structure is of steel and the main block has a pitched and overhanging roof. A tower at one end conceals the chimney of the central heating plant.

At one end of the hall is the station restaurant, separated by a glazed wall. This has its end wall plastered as a contrast to brick or glazing. Between the ticket office and the restaurant is the entrance to the station platforms. Beyond this main building lies a single storey block containing the offices for customs and passport control staff and an area for inspecting passengers' baggage, etc. In front of the station are local and inter-urban bus terminals and parking space for taxis and cars.

With walls of smooth tiles, bricked surfaces and large windows, the Den Helder station-restaurant is an attractive place to eat

Den Helder — *Architect Ir. G. J. van der Grinten b.i.* — This is a terminus with an unusual main building which is six sided and of brick construction. To one side is a decorative tower with large clocks on two sides and which again conceals the chimney from the central heating installation. The building has a central circulating area with the restaurant, buffet, kitchen and stores, toilets and rooms for train personnel, on one side. On the other side are the ticket office, baggage room, offices for station staff and customs offices. Below the building is an extensive bicycle store. The wall at one end of the restaurant is principally of glass with doors giving access to a terrace which can be used in summer. This terrace adjoins the bus station. The six-sided building provides interest in shape, while the use of smooth tiles, brick and glazed areas provides contrasts in texture —as well as being simple to keep clean. The platforms are protected by "umbrella" roofing, which is supported by a reinforced concrete structure.



Rebuilt so as to eliminate a busy level crossing, the Heemstede–Aerdenhout station now has an overall appearance of efficiency

Heemstede-Aerdenhout — *Architect Ir. K. van der Gaast b.i.* — This suburban station has been completely rebuilt to eliminate a busy level crossing. Tracks have been raised and the station is elevated above street level. It handles a heavy commuter traffic at peak hours. Walls are largely tiled for easy cleaning, while the structure is of concrete. Sizeable windows make the station light and airy. There are wide staircases and spacious entrances to enable large numbers of passengers to move freely. The design is clean, simple and without any unnecessary decoration. The waiting room at platform level has a tiled floor, simple wooden seats and benches, brick walls and a wood strip ceiling for contrast.

Gares Hollandaises Modernisées

Depuis la fin de la guerre les Chemins de Fer Néerlandais (Nederlandsche Spoorwegen) ont modernisé presque toutes leurs gares, 35 ont été complètement reconstruites, tandis qu'un grand nombre d'autres ont été profondément modifiées. Les destructions de la guerre ont permis la construction de centres intégrés de transport, comprenant l'élimination de passages à niveau en plusieurs endroits. On a évité la standardisation —sauf pour les petites gares car on a constaté que le développement de la technique et du trafic exige des projets flexibles. Dans de nombreux cas on a, toutefois, utilisé des éléments standardisés.

Niederländische Bahnhöfe erhielten neues Aussehen

Nach dem Krieg haben die Niederländischen Eisenbahnen (Nederlandsche Spoorwegen) fast alle Bahnhöfe erneuert. Ungefähr 35 sind vollständig neu aufgebaut, während viele andere weitgehend modernisiert wurden. Oft waren Kriegsschäden Anlass die Transportzentren grosszügig auszubauen; im Rahmen dieser Bauarbeiten wurden auch in vielen Ortschaften Niveaukreuzungen entfernt. Ausser bei kleinen Bahnhöfen wurde Vereinheitlichung vermieden, da man davon ausgegangen ist, dass der Bauplan den verkehrstechnischen Entwicklungsmöglichkeiten Rechnung tragen muss. In manchen Fällen wurden allerdings auch genormte Einzelteile verwendet.

Modernización de las Estaciones holandesas

Durante la posguerra los Ferrocarriles holandeses (Nederlandsche Spoorwegen) han modernizado casi todas sus estaciones de pasajeros. Unas 35 se han reedificado completamente y muchas otras han sido reconstruídas. Los estragos de guerra han permitido la construcción de centros integrados de transporte, lo que ha hecho posible la eliminación de los pasos a nivel. Se ha evitado la normalización—excepto para menores estaciones—porque es evidente que el desarrollo de la técnica y del tráfico exigen diseños flexibles. Sin embargo en muchos casos se han utilizado componentes standard.

Modernization of the 70-km line across the island of Fyn has resulted in improved traffic conditions for the DSB

DSB Completes CTC Modernization

In recent months the Danish State Railways (DSB) completed the final phase of an eight year program designed to modernize traffic handling on the 70-km line across the island of Fyn.

In 1952, when DSB began investigating the need to modernize existing signaling equipment, it discovered that the double-track main line between the Nyborg ferry station and the Fredericia junction had been particularly neglected in the past and required efficient, up-to-date equipment. Every train moving between Nyborg and Fredericia required 33 persons to handle dispatching and supervise level crossings. Further investigations showed that the simultaneous modernization of track layouts; interlocking block signaling; the installation of telecommunication equipment, as well as the introduction of automatic signals at level crossings, would result not only in improved traffic conditions but also show sufficient savings to ensure a reasonable profit and cover depreciations of capital invested.

Each station was subsequently studied to see whether the track layouts could be changed by either reducing the number of sidings or eliminating them altogether. (In one case an entire station was replaced by a signal halt.) Having already replaced a large number of its steam locomotives with diesels, DSB gave special attention to adjusting the remaining sidings to meet current needs.

When the modernization studies were undertaken the mechanical interlocking plants were highly unsatisfactory from both a safety and operational point of view. At that time there were only four quite small, experimental relay interlocking plants in operation. It was not until the Glostrup interlocking plant was put into service in 1953 that the DSB achieved a standard design for relay interlocking plants. In the process of installing this plant it was found that the station signaling system then in operation had to be substantially modified to ensure greater safety and a more flexible utilization of the track layouts. The main improvements were the division of the main tracks into signal-controlled sections and the use of speed signaling for approaching trains.

As a result of standardization the interlocking plants for all minor stations (including CTC controlled ones) can now be supplied ready-wired and tested from the DSB's signaling workshop in Copenhagen.

Since most of the stations that were to be operated by CTC did not have inter-platform tunnels, it was necessary to supplement the interlocking plants by entirely new apparatus for the protection of passengers crossing the tracks.

A dual system was chosen, consisting of automatically controlled signs reading "Look out for Train" and automatically controlled loud-speakers which announce a "Do-not-cross-the-track, train-is-coming" message.

In 1952 the Fyn line was equipped solely with manual block signals over only a small part of the system. For the most part, train movements were directed by telephone. An extension of the manual system was far from feasible as well as uneconomical, but experience with automatic block signals was lacking, particularly in regard to how great a distance a reliable track circuit could be installed and what type of track relays were most suitable.

At certain sites, four to six kilometer track circuits were installed on a trial basis and theoretical calculation for longer ones was begun. The aim was to introduce a method of calculation and regulation which would permit all the planning and design work to be done by non-engineering personnel.

The choice of a suitable type of track relay was extraordinarily difficult. The various alternatives were: code following relays; frequency-controlled relays; phase controlled relays; and DC polarized relays. The latter were selected since fairly simple emergency power plants can be rigged on DC track circuits. It had

been expected that such plants would be required, as later proved to be the case, since the normal power supply would come through small "undependable" transformer stations. The track relay selected is a polarized telegraph relay in parallel with a neutral DC relay. The contacts of the two relays are in a series and actuate three auxiliary relays which are the control relays for signal aspects. The operating and release functions of all relays are checked.

The arrangement of the block signals is such that trains can run on both the right and left-hand tracks. However, the number of block signals on the left-hand track is only half as large as on the right since the left-hand one is used only in the event of break-downs and during maintenance work.

The DSB had had experience only with automatic short-arm gates on single track lines before the installation of CTC was begun. Nevertheless, in 1953 it was decided to introduce automatic long-arm gates on double track railways. Since the Fyn line is divided into comparatively short block sections (1.5–2 kilometers) it was desirable to use special control signals for the gate installations. It was therefore necessary to interlock the gates and block signals so that the latter regulated their operation. This proved to be one of the most difficult phases of the entire program.

Since the automatic block signals required the laying of cables along almost the entire line, it was decided to investigate the desirability of simultaneously cabling all telecommunication circuits. The results indicated that it would be economical to lay a separate telecommunication cable in which long distance calls would be made on a carrier circuit. Thus the interruption of service which had been so common on the overhead lines during winter was eliminated.

Even in the early phases of the study of conditions on the Fyn line it became clear that it was desirable to control certain stations from neighboring ones. However, a variety of circumstances suggested that even greater advantages such as a reduction in personnel and improvement of operations would result if all stations on the line were controlled from a central location. In 1953 it was finally decided to introduce centralized traffic control along the entire line from Nyborg to Fredericia with the control center located in Odense. Installation of the system was divided into two stages: The Nyborg-Tommerup line (which was completed in 1957) and the Tommerup-Fredericia line (which was finished three years later).

CONTINUED

Télécommande au Danemark

Les Chemins de fer de l'Etat danois (DSB) ont achevé, l'automne dernier, un programme de modernisation de la circulation des trains sur la ligne de 70 km traversant l'île de Fünen; ce programme était prévu de huit ans.

En 1952, au cours d'une enquête, on constata que la grande ligne à double voie reliant le port des ferry-boats de Nyborg au noeud ferroviaire de Fredericia avait été négligée dans le passé et qu'elle devait être équipée de façon rationnelle et moderne. C'est ainsi que, jusque-là, il fallait jusqu'à trente-trois personnes pour assurer la circulation d'un seul train sur cette ligne. En examinant la situation de plus près, on se rendit compte qu'un renouvellement des installations de la voie, du block de ligne et des moyens de télécommunication permettrait, combiné avec un service de protection automatique aux passages à niveau, d'améliorer la circulation des trains et, en plus de cela, de réaliser suffisamment d'économies pour laisser un bénéfice d'exploitation et couvrir les frais de capitaux.

Les signaux et les installations de sécurité nécessités par la télécommande ont été fournis par la fabrique suédoise L. M. Ericsson. Les DSB se sont occupés de leur montage.

L'article ci-contre décrit principalement le système de signalisation conçu par la maison L. M. Ericcson.

Signaltechnische Fernsteuerung in Dänemark

Die Dänischen Staatseisenbahnen (DSB) beendigten letzten Herbst ein Achtjahresprogramm, wodurch sie die Verkehrsabwicklung auf der 70 km langen Strecke quer durch die Insel Fünen modernisierten.

Wie die im Jahre 1952 durchgeführte Untersuchung gezeigt hatte, war die doppelspurige Hauptlinie zwischen dem Fährebahnhof Nyborg und dem Verkehrsknotenpunkt Fredericia in der Vergangenheit besonders vernachlässigt worden und benötigte eine moderne und rationelle Betriebsausrüstung. So hatten die für jeden Zug dieser Linie jeweils ausgeführten betriebsdienstlichen Verrichtungen bisher 33 Personen in Anspruch genommen. Bei näherer Prüfung der Sachlage ergab sich dann, dass eine Erneuerung der Gleisanlagen, des Streckenblocks, der Fernmeldeeinrichtungen und die automatische Bedienung der Bahnübergänge nicht nur die Betriebsabwicklung verbesserte, sondern auch genügend Einsparungen brächte, um neben einem angemessenen Betriebsertrag auch die Kapitalkosten zu decken.

Die für die signaltechnische Fernsteuerung notwendige Signal- und Sicherheitsausrüstung wurde von der Elektrizitätsgesellschaft L. M. Ericsson in Schweden geliefert, während die DSB die eigentliche Installation der Anlagen ausführte.

Vorliegender Artikel beschreibt hauptsächlich die von L. M. Ericsson entwickelte Signalordnung.

Mando centralizado de la circulación en Dinamarca

En otoño pasado los Ferrocarriles del Estado Daneses (DSB) terminaron la etapa final de un programa de ocho años, el que tendía a modernizar la manipulación del tráfico en la línea de 70 km. a través de la isla de Fyn.

Cuando, en 1952, los DSB investigaron la necesidad de modernizar la señalización, se descubrió que la línea principal de doble vía entre la estación ferrobarco de Nyborg y la bifurcación de Fredericia se había descuidado en alto grado y necesitaba instalaciones eficientes y modernos. Cada tren recorriendo entre Nyborg y Fredericia necesitaba 33 personas para el despacho y la guarda de los pasos a nivel. Las investigaciones mostraban que la modernización simultánea del trazado de la línea, el enclavamiento de las señales del bloqueo, la instalación de un equipo de telecomunicación y la introducción de señales automáticas para los pasos a nivel traerían consigo no sólo el mejoramiento de las condiciones del tráfico, sino también suficientes ahorros para asegurar ganancias regulares y compensar depreciaciones del capital invertido.

La Compañia sueca de L. M. Ericsson suministró el equipo para las señales, los relés de seguridad, el enclavamiento y las señales de bloqueo y los aparatos CTC. Los DSB ejecutaron la instalación. Este artículo contiene una descripción de la codificación elaborada por la casa de L. M. Ericsson.

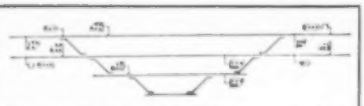


Fig. 1. Station with siding on double-track line (Hjulby).

Controls:

4 entrance routes, right-hand track
4 exit routes, right-hand track
4 routes for left-hand track running
6 call-on-signal aspects
4 stop aspects for entrance and exit signals
4 emergency release of routes
4 selection of method of operation
3 permission for local control of points
7 point lighting and heating, night illumination etc.
3 new complete indication and lock-out of indication transmitter
2 manual intervention in automatic gate functions
19 initiation of telephone calls
7 spares
(7 of the above are twin controls)

Fig. 2. Station without sidings on double-track line (Bred).

Controls:

2 automatic block through the station
2 entrance routes, left-hand track
2 exit routes, left-hand track
1 stop aspect for entrance and exit signals
2 emergency release of routes
2 permission for local control of points
4 point illumination etc.
2 new complete indication and lock-out of indication transmitter
2 manual intervention in automatic gate functions
13 initiation of telephone calls
4 spares
(6 of the above are twin controls)

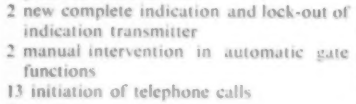


Fig. 3. Station with siding on single-track line. The station tracks are long enough to permit simultaneous entrance of trains from both sides.

Controls:

2 entrance routes
2 exit routes
2 locking of block system for movement from neighbouring station
2 call-on-signal aspects
1 stop aspect for entrance and exit signals
2 emergency release of routes
1 permission for local operation of points
2 operation of points
6 point lights and heating etc.
2 new complete indication and lock-out of indication transmitter
2 manual intervention in automatic gate functions
9 initation of telephone calls
3 spares
(7 of the above are twin controls)

DANISH CTC CONTINUED

The completed project comprised:
9 stations with sidings,
5 stations without sidings,
about 77 automatic block sections, and,
7 automatic gate installations.

The Swedish electrical company of L. M. Ericsson provided the equipment for the signals, safety relays, the interlocking and block signals, and all the CTC apparatus while DSB carried out the actual installation.

L. M. Ericsson's first CTC installation was built as early as 1938 on the Saltsjobaden line in Sweden, a distance of about seven miles with five field stations. The installation is still in operation and has so far functioned satisfactorily.

Briefly the L. M. Ericsson CTC is an electromechanical system made up of telecommunication relays of standard type. It is rapid enough in operation and no reason has yet been found to change to an electronic system, which would prove more expensive. The CTC equipment can be connected to any type of relay interlocking plant. The control and indication devices can be designed to any railway requirements, and the CTC plants delivered show that these can vary considerably. The company particularly recommends the keyset system, however.

Fig. 1, 2, and 3 (on the left) show the three types of standardized station track layouts selected for the Danish railways as well as the number of controls required by each. Since L. M. Ericsson transmitters and receivers are equipped to handle 36 control translations and 49 indications two were required for the diagram in Fig. 1, while one each sufficed for the other two.

Field locations are equipped with a control board from which the interlocking plant can be operated under exceptional conditions when released by the Odense CTC office. They are normally controlled in the following manner:

• The interlocking plant is automatically operated by trains approaching the station which establish route lockings and signal indications without the control office being involved. This method can be used either for one train direction at a time or for both directions at once.

• The interlocking plant is operated from the control office. Under such manual operation portions of the track can be released for local operation.

In both cases the field location sends indications to the control office which enables it to follow the flow of traffic.

At the first CTC operated stations transmissions of "dangerous" controls (signaling to proceed on call-on-aspect) were made by means of two "control numbers" in order to avoid the execution of "false" controls. This procedure has since been entirely abolished because the coded control system employed by L. M. Ericsson has proved to be extremely safe. DSB is convinced that CTC equipment —and in particular the transmission of controls—should have roughly the same degree of safety as employed in the normal operations of interlocking plants. Experience has indicated that rules governing the signaling at a station where the interlocking plant fails must be based upon the use of telephonic communication to place the responsibility of safety upon the CTC operator. The DSB assumes that CTC operated stations will be unattended and that engineers cover such long distances they cannot have local knowledge of individual stations.

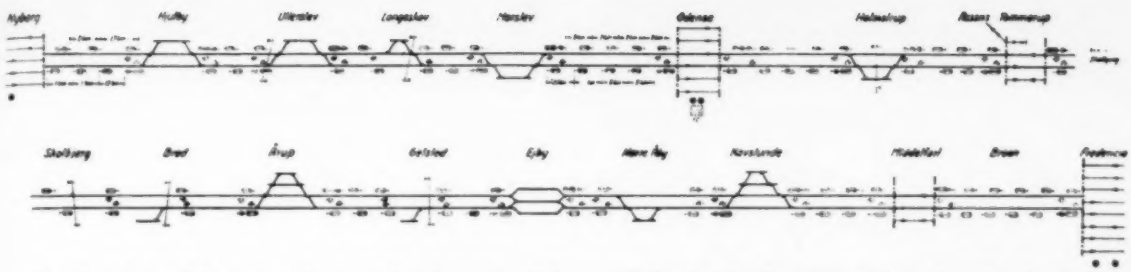
The execution of the control is carried out only when the CTC office has received the answering impulse and has sent back an execution impulse. If there is the least disturbance in impulsing, the control will not be executed.

For certain controls use is made of "twin controls"—i.e., one control is employed for two objects. For example, the first transmission of the control can be used for the change of a point from normal to reserve, whereas the next transmission of the same control can be used to change it from reserve to normal. An increase in the capacity of the CTC equipment (in some cases by as much as 30 per cent) can be achieved by using the twin controls.

The equipment used by the DSB is capable of distinquishing between "blocked" and "stored" controls. If a station received a blocked control, which cannot for some reason be executed at the given moment, the control is immediately marked in the CTC office as blocked, without the office needing to await the corresponding indication. Stored controls are ones which cannot be immediately executed, but which will be stored for execution when the situation at the station permits.

This method of splitting up the controls has resulted in many advantages. The storing of controls relieves the staff of much work and means a single person can without difficulty be in charge of the CTC for a very long section.

Controls are also used to give permission to trains at terminal stations to enter the line before trains can be dispatched. In order to tie up the CTC operator as little as possible, storage equipment is provided permitting the release of three successive trains. The storage equipment is located in the CTC office which means that a control for



Track and signal layout of the main line between Nyborg and Fredericia after completion of modernization

clearing the exit signal for the following train is automatically transmitted when the office receives an indication that the first train has departed.

A control asking for "new complete indication" can be transmitted to every station. At the CTC office all earlier indications for the particular station are first cancelled after which all indications assume the most restrictive aspect. When the station has received the control, it sends a complete indication transmission to show the position of all signaling equipment. This ensures that the CTC office staff can obtain completely fresh indications at any moment.

The DSB consider it important that the automatic functions of the short-arm gates be kept under observation in case of a failure to respond to commands. At gate installations on CTC sections certain of the controls have been utilized to put the automatic gate equipment out of action. This proved advantageous because of the large amount of work-train traffic and maintenance work that was necessary while the CTC system was being installed. The Odense office receives an alarm if the gates are not fully raised or lowered within 45 seconds and when the gates have been lowered for more than eight minutes.

The number of indications is considerably larger than the number of controls. An investigation of the CTC circuits on the Odense-Nyborg line (four field locations, 25 block sections, and about 60 trains in each direction) showed that 7,000 indications and 350 controls were transmitted in a 24 hour period.

When the installations for the Fyn line were planned DSB had no experience in how high a level of occupation could be permitted on a pair of CTC wires. If the occupation is too high, an indication may be delayed; in unfavorable circumstances this may mean that it is entirely lost or that two indications are transmitted in wrong sequence. Considerable emphasis was, therefore, placed on reducing the number of transmissions.

This was achieved in the following manner:

- If the 60 + 60 trains had transmitted indications corresponding to all signals and track circuits that they pass, the number per 24 hours would have been about 13,000.
- The number of indications has been reduced by omitting the block signals and showing only the associated track circuits. At the stations, indications are given of the track circuits passed by the train in groups of three track circuits for each direction of movement. Consequently, the number of indications is reduced from 13,000 to about 10,000.
- The coded indication system used by L. M. Ericsson permits the quick successive transmission of several indications from the same field location, so that two or more indications require only one occupation on the circuit. This brings the previously mentioned 10,000 indications down to about 7,000 every 24 hours.

In assessing the occupation of the line wires, experience has been drawn from telephony which has possessed efficient methods of calculation since Erlang's first investigation of the theory of occupation, congestion, and waiting time. It must be remembered that individual occupation of the CTC circuits are of the order of seconds whereas on a telephone circuit they are of the order of minutes.

Measurements on one of the CTC operated lines showed the following figures:

24 hour period: average occupation 4 sec. per minute.
60 minute period: average occupation 9 sec. per minute.
1 minute period: average occupation 30 sec. per minute.

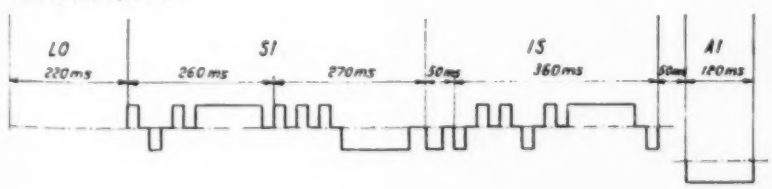
The indication transmitter first sends two DC impulse groups with four impulses each, so informing the CTC office

CONTINUED

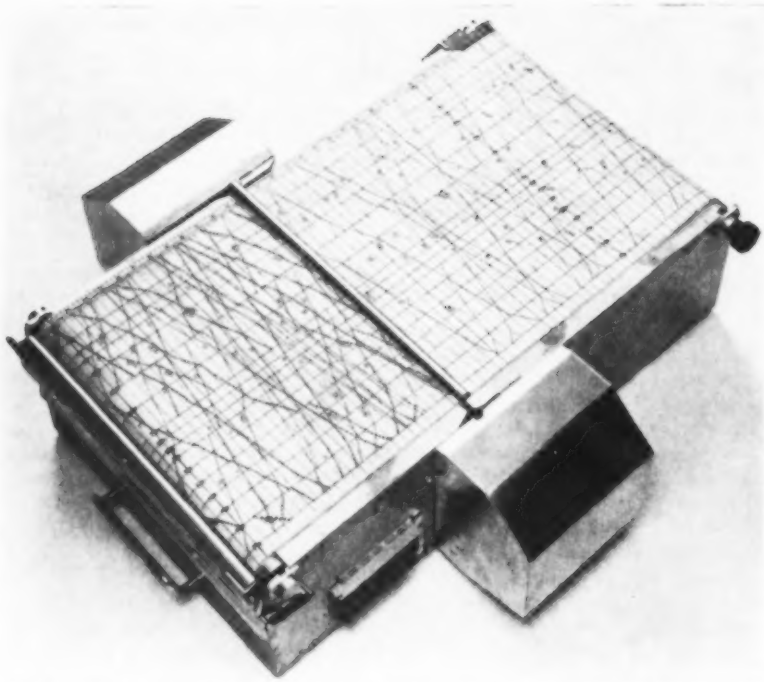
Control: 1,750 ms

Code for a control transmission
LO: line occupation
SS: station selection
CS: control selection
AI: answering impulse from field station
EI: executive impulse from CTC office

Indication: 1,330 ms



Code for an indication transmission
LO: line occupation
SI: station indication
IS: indication selection
AI: answering impulse from CTC office



L. M. Ericsson traingraph (above) can be fitted to any control and indication system. Simplicity is a major feature of the keyset control machine (below)

DANISH CTC CONTINUED

which field location the transmission comes from. In the same way as in the transmission of controls, each of these groups must include one impulse of opposite polarity and the last impulse must be long.

Then follows the impulsing which informs the CTC office which functions have changed position since the last indication. The relays which repeat the position of functions are divided into seven groups with seven relays in each group, so that 49 functions (each with two positions) can be indicated. For every seven-relay group there is a common relay which, when picked up, indicates that no change has occured in the group, whereas the down position indicates a change.

To communicate the position of the function, the transmitter sends a series of DC impulses of which every seventh is long. In the case of a relay group in which no function has altered position since the last indication, a normal polarity impulse is transmitted for the entire group.

In the case of a group in which one or more functions have altered position a reversed polarity impulse is transmitted first, after which, for each relay in the group, an impulse is sent out, normal polarity indicating the relay is up but reverse polarity if the relay is down. The subsequent relay groups are indicated in a similar manner. But if no change has occured in them, the transmitter stops and awaits a reversed polarity answering impulse from the indications receiver at the CTC office after which the indication transmitter is disconnected.

Thus, apart from the station selection impulsing, the transmission of an indication does not consist of a given number of impulses. If a function associated with a relay in the first group has changed position, the indication transmitter sends altogether $(2 \times 4) + (1 + 7) = 16$ impulses. If the function belongs, for example, to the third relay group, $(2 \times 4) + (3 + 7) = 18$ impulses are transmitted. If one or more relays in each group has changed position, $(2 \times 4) + (7 \times 8) = 64$ impulses are transmitted.

On the transmission of indications the CTC office checks that the station impulsing is correct, i.e., that the correct answer of two reversed polarity and two long impulses have been received. During installation impulsing, on the other hand, the CTC office checks merely that every seventh impulse is long. Thus the indication system does not possess the same measure of safety as the control system and it cannot be expected that false impulses will be discovered.

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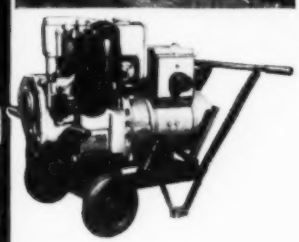

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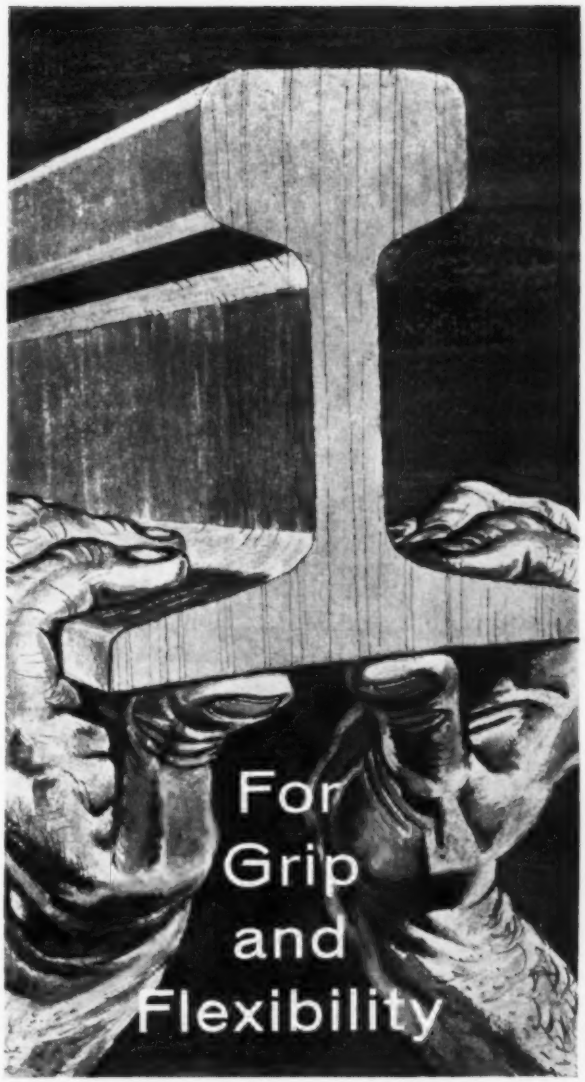

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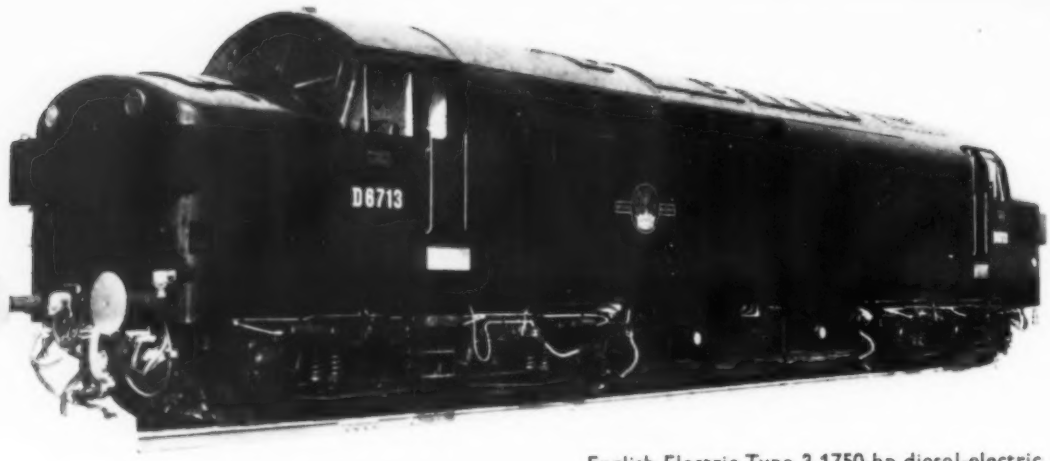
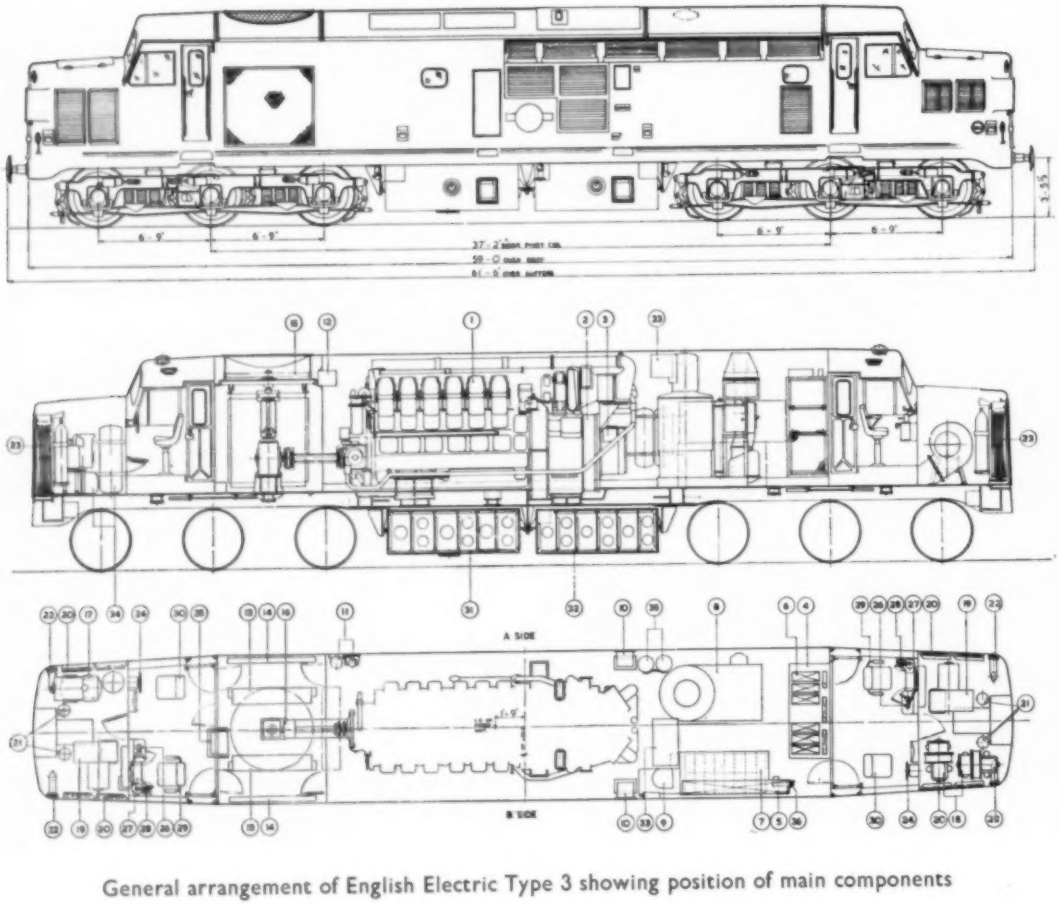


English Electric Type 3 1750-hp diesel-electric

First Deliveries of New Diesels Fo



General arrangement of English Electric Type 3 showing position of main components

1 Engine (12 C. S. V. T.)
2 Main generator (EE 822/10 G.)
3 Aux. generator (EE 911/5 C.)
4 Main equipment frame
5 Aux. equipment frame
6 Field resistances
7 Batteries
8 Train heating boiler
9 Lavatory
10 Water filling chute
11 Engine fuel supply unit
12 Radiator header tank
13 Radiators
14 Radiator shutters
15 Radiator fan
16 Radiator fan drive
17 Compressor
18 Exhausters
19 T. M. blowers
20 Air filters
21 CO_2 bottles
22 Sandbox fillers
23 Flexible gangway
24 Handbrake
25 Cooker
26 Master Controller
27 Vacuum brake valve
28 Air brake valve
29 Driver's seat
30 Assistant's seat
31 Fuel tank, 920 gallons
32 Water tank, 800 gallons
33 Lavatory header tank
34 Main reservoirs
35 Supply reservoirs
36 Westinghouse equipment

British Railways are now receiving the first deliveries of: 79 1750-hp type 3 diesel electrics, designed and built by English Electric Co. Ltd., in conjunction with their associates, The Vulcan Foundry Ltd.; 22 3300-hp type 5 Deltic diesel electrics by the same builder; and 95 1700-hp type 3 diesel hydraulics, designed and built by Beyer Peacock (Hymek).

Types 3 and 5 main-line diesel-electric locomotives have been ordered for the Eastern and North Eastern Regions, and type 3 diesel hydraulics will form part of the Western Region dieselization program.

els For Britain

The type 3 can be operated in multiple-unit with similar locomotives or with types 1, 2 and 4 supplied by English Electric. They can also be operated in multiple-unit with the majority of diesel locomotives of types 1 to 4, built by other manufacturers.

The power unit of the new type 3 Co-Co design is a 12-cylinder English Electric 12CSVT type engine rated at 1750-hp at 850-rpm. A four-stroke type with cylinders in V formation, it is turbo-blown by two Napier exhaust gas driven turbo-blowers. The air is cooled in charge coolers after leaving the turbo-blowers prior to entering the cylinder.

The main generator is bolted solidly to the diesel engine and, together with the auxiliary generator overhung on the main generator, form an integral power unit. Pairs of radiator panels are mounted one behind the other, on either side of the locomotive. The outer panels are interconnected and cool the water circulating in the two charge air coolers and the engine lubricating oil cooler. The inner panels are also interconnected and are for engine jacket and turbo-blower water cooling. A mechanically driven fan draws air across the pairs of radiators and expels it through a grill in the roof.

The main generator is a direct current, self-ventilated single bearing machine continuously rated at 1107-kw at 850-rpm. In addition to the field windings which are used for normal running, it is provided with a series field winding which is used when the generator is connected across the battery for engine starting. Power output is varied by control of the diesel engine speed and main generator field excitation. The auxiliary generator is a

CONTINUED

Nouvelles locomotives pour la Grande-Bretagne

Les premières des 79 locomotives diesel-électriques du type 3 pour lignes principales commandées à l'"English Electric Co" ont été livrées. Elles sont essentiellement destinées au trafic mixte des régions est et nord des Chemins de fer britanniques.

La S.A. "Beyer Peacock (Hymek)" a commencé la livraison, qui prendra fin en 1963, de 95 locomotives diesel-hydrauliques du type 3, de 1700 CV. Ce type 3, d'un genre tout nouveau, a un moteur Bristol-Siddeley-Maybach MD 870, atteint une vitesse maximum de 144 km/h et sera utilisé pour le trafic général des lignes principales.

De son côté, l'"English Electric Co" est en train de fournir 22 locomotives diesel-électriques Deltic Co-Co type 5, d'une puissance de 3300 CV. Cette machine, d'une charge maximum de 16,5 tonnes par essieu et d'un poids de 99 tonnes en service, pèse 7 tonnes de moins que son prototype, que les Chemins de fer britanniques ont récemment retiré des essais. La force est produite par deux moteurs Napier-Deltic D18–25, chacun directement accouplé à une génératrice de courant et pourvu d'une génératrice auxiliaire entraîné par la boîte de vitesses. On attend des nouveaux moteurs une notable accélération de la circulation des trains.

Neue Diesellokomotiven für Grossbritannien

Die ersten der 79 von der English Electric Co. bestellten diesel-elektrischen Hauptlinienlokomotiven des Typen 3 wurden beendigt. Sie sind hauptsächlich für den gemischten Verkehr der Eastern und North Eastern Regions der Britischen Bahnen bestimmt.

Die Lieferung der 95 von Beyer Peacock (Hymek) AG bestellten diesel-hydraulischen Lokomotiven des Typen 3 von 1700 PS hat begonnen und wird im Jahre 1963 beendigt. Typ 3 von ganz neuer Bauart besitzt einen Motor des Systems Bristol-Siddeley-Maybach, MD 870, erreicht eine Höchstgeschwindigkeit von 144 km/h und ist für den allgemeinen Verkehr auf Hauptlinien bestimmt.

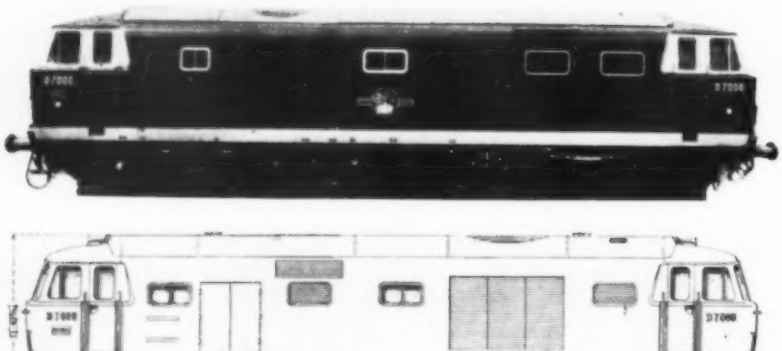
Die English Electric Co. steht ferner im Begriff, 22 diesel-elektrische Lokomotiven, Deltic Co-Co Typ 5, von 3300 PS zu liefern. Mit einem Höchstachsdruck von 16.5 t, einem Dienstgewicht von 99 t, ist diese Lokomotive 7 t leichter als ihr Prototyp, den die Britischen Bahnen kürzlich aus dem Versuchsbetrieb zurückgezogen haben. Die Kraftanlage besteht aus zwei D18-25-Napier-Deltic-Motoren, wovon jeder direkt mit einem General-Electric-Generatoren gekuppelt und einem Nebengeneratoren versehen ist, dessen Antrieb des Motorphasengetriebe besorgt. Von den neuen Motoren wird eine wesentliche Beschleunigung des Zugverkehrs erwartet.

Nuevas locomotoras Diesel para la Gran Bretaña

La English Electric Co. Ltd. ha terminado la construcción de las primeras de 79 locomotoras de servicio de línea diesel-eléctricas tipo 3. Servirán estas locomotoras (tipo Co-Co) en primer lugar en servicio mixto en las regiones del este y del nordeste de los FF.CC. británicos.

Ha comenzado también la entrega de 95 locomotoras diesel-hidráulicas 1700 C.V. tipo 3 compradas a Beyer Peacock (Hymek) Ltd. Se terminará la entrega de todas las 95 unidades en 1963. La diesel-hidráulica tipo 3 es de diseño enteramente nuevo accionada por una máquina Bristol Siddeley Maybach MD. 870. Operará en las líneas principales en servicio general y tiene una velocidad máxima de 144 kilómetros por hora.

La English Electric Co. Ltd. está entregando también 22 de las locomotoras diesel-eléctricas de 3300 C.V., Co-Co, tipo 5 Deltic. Siendo la carga máxima por eje 16.5 toneladas, el peso total en orden de marcha no es más que 99 toneladas — unas 7 toneladas más ligero que el del prototipo que se ha retirado recientemente del servicio experimental en los FF.CC. británicos. El equipo motor consiste de dos motores Napier Deltic D18–25 acoplados directamente a un generador English Electric con un generador auxiliar accionado por la caja de velocidades de la máquina. Se espera que las nuevas locomotoras acelerarán los servicios.



Beyer Peacock (Hymek) 1700-hp type 3 diesel-hydraulic for Western Region

DIESELS FOR BR CONTINUED

self-ventilated DC machine with a carbon pile regulator to maintain a constant output of 110 volts.

Auxiliaries include two exhausters, a compressor, two traction motor blowers, train heating boiler, lubricating oil priming and fuel pumps. The exhausters provide vacuum for operating the train brakes while the compressor provides the compressed air supply for the locomotive brakes, horns, sanding gear and for operating the control gear. The radiator fan is roof-mounted and mechanically driven from the diesel engine. As BR have plans for substituting electric heating for steam heating at some future date, the Clayton train heating boiler may be removed and a generator interposed between the main and auxiliary generators.

The six axle-hung nose-suspended traction motors drive the road wheels through single reduction spur gearing. They are interchangeable with traction motors fitted to the Deltic class 5 locomotives. They are the four-pole series wound type. In order to extend the range of locomotive speeds over which the full engine power is available, provision is made for weakening the field strength of the traction motors by field divert resistances. The motors are force ventilated from a blower in the locomotive superstructure, air being led to inlets at the commutator end by ducts and flexible bellows.

The bulk of the control gear is located in a single cubicle placed across the locomotive and facing into No. 2 cab. The remainder is located in a case mounted on the locomotive side above the battery box.

Wheel slip protection circuits are included which reduce the tendency for wheel slip to occur. In the event of wheel slip commencing, the driver is warned by an indicator light and tractive effort is automatically reduced, until the slipping ceases. Additional warning lights at the driving position indicate that the diesel engine has shut down or a general fault has occurred. The general fault light indicates that one or more faults have occurred, each of the four faults having its own indicator light on the bulkhead in No. 2 cab. The four faults indicated are: low oil pressure; low fuel level; high water temperature; and traction motor blower failure.

Master controllers are located in each cab. Control circuits are energized by electro-pneumatic and electro-magnetic contactors and relays. The speed of the diesel engine may be continuously varied from 450-rpm to 850-rpm and the loading on the engine is automatically adjusted by the load regulator so as to cause the engine to deliver the maximum available output corresponding to the selected engine speed. This means that for a given load demand the diesel engine runs at the lowest possible speed to meet this requirement. For the first time on English Electric locomotives supplied to BR the load regulators are activated by a hydraulically driven vane motor operated by the governor from the engine oil pressure.

The superstructure incorporates a cab at each end and there are nose ends which accommodate certain auxiliaries. The underframe is made up of three sections fabricated together to form an integral unit consisting of a center section of two longitudinal joists, supporting the power unit, fuel and water tanks and the two identical outer sections of two fabricated members, over the bogies. These are cross connected by transoms of welded construction to form the bogie pivot centers and an adequate number of cross stretchers is provided. The standard BR screw couplings and side buffers are fitted with provision for fitting buck-eye couplers in the future.

Fuel and water tanks are underslung from the center of the underframe and battery boxes are at one end of the engine room. Superstructure side framing is prefabricated and welded to the underframe. There are removable roof sections over the power unit, control cubicle and the boiler to simplify maintenance.

The bogies have frames of fabricated construction. The superstructure load is carried on four side bearers on each bogie bolster and is transmitted through four nests of coil springs to two spring planks suspended by swing links from the bogie frame. Dampers are fitted between the bolster and the spring plank adjacent to each of the four nests of coil springs. From the bogie solebars, the load is distributed through four pairs of coil springs to equalizing beams underslung from the roller-bearing axle-boxes.

The driver's controls in each cab are laid out in the same way as those in English Electric's type 4 locomotives.

Deliveries have also commenced of 95 1700-hp type 3 diesel-hydraulic locomotives which were ordered by the British Transport Commission for further stages of the Western Region's dieselization program. Deliveries of all 95 units will be completed in 1963.

Beyer Peacock (Hymek) Ltd., in which Bristol Siddeley Engines Ltd. and J. Stone & Co. (Deptford) Ltd. are partners with Beyer Peacock & Co. Ltd., initially received an order to supply 45 of these type 3 locomotives but this order was subsequently increased to 95. The type 3 diesel-hydraulic is a completely new design powered by one Bristol Siddeley Maybach MD 870 engine and having a K 184U Stone-Maybach Mekydro hydraulic transmission. The locomotive is designed for general purpose work on main lines and has a maximum speed of 144 km/h.

Considerable attention in the design of the locomotive has been given to accessibility of parts making for easy maintenance in service.

The Bristol Siddeley Maybach engine is pressurized and intercooled and its rating of 1700 bhp is achieved at 1500 rpm. The actual NTP rating of this engine is 1920 bhp at 1500 rpm. The final drive

gearboxes are of the Stone-Maybach type-C33V on the inner axles and C33 on the outer axles.

The control equipment is that of Brush Electrical Engineering Co. Ltd. and arranged for multiple-unit operation, comprising pneumatic control for diesel engine speed and electrical control for all other equipment. Most of the control equipment is housed in a dustproof cabinet in 'A' cab. The Dyno-starter is also by Brush and is coupled to the transmission on the input side of the torque convertor.

Cooling equipment is by Serck-Behr and is a self-contained unit incorporating header tanks fitted with a fan driven by a hydraulic motor. Fan speed is thermostatically controlled. The cooling system covers the engine water jacket, the intercoolers and the transmission heat exchanger. A Stone-Vapor "Watchman" oil-fired pre-heater is provided for raising the water temperature to optimum figure before starting and thus minimizing engine wear. For train heating purposes a Stone-Vapor OK-4616 type automatic boiler is provided.

Braking equipment consists of air-brakes on the locomotive and a vacuum brake for the train. The engine braking can be controlled by the vacuum brake valve or independently by the straight air brake valve. Braking equipment is by the Laycock Engineering Ltd. with the exception of the exhausters which are the latest Northey flange-mounted type supplied by Gresham & Craven and driven by motors supplied by Brush.

The locomotive runs on two four wheeled cast steel Commonwealth design bogies manufactured by the English Steel Corporation. They are of the swing bolster type and the suspension system comprises triple elliptic spring nests between the equalizer beams and the bogie frame and laminated springs under the bolster.

The underframe of the locomotive is of welded construction and built from rolled steel joists, plates and sections. The superstructure, including cabs and bulkheads, is made of steel sheet welded to a framework of steel sections. Cab canopies are fiberglass moldings and the cab windows are of Therglas electrically heated glass. Sound insulation in the cabs is provided by means of fiberglass on cab bulkheads and roofs.

Protection devices for engine overspeed and also for locomotive overspeed are provided and other protective devices are integrated in the control system and cover lubricating oil, cooling water and transmission oil temperatures and the water level in the radiator header tanks.

The English Electric Co. Ltd., is in the course of delivering 22 of the 3300-hp Co-Co type 5 Deltic locomotives. The prototype Deltic had completed over three million kilometers with BR up to the time of its withdrawal.

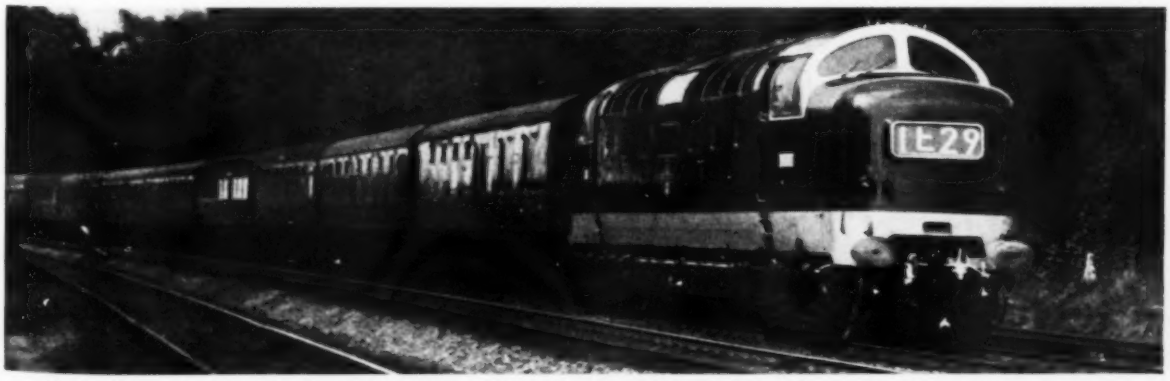
With the introduction of the Deltic diesel-electric locomotives, British Railways were planning extensive alterations to passenger train schedules this past September. The re-cast timetable not only includes a speed up of existing trains, but the introduction of a number of completely new schedules. The routes affected include those from London to Leeds and Bradford, London to Halifax and Huddersfield and Sheffield. Fastest service will be "The West Riding" express which will make the 171-km run between Hitchin and Retford in 89 minutes, an average speed of nearly 116 km/h.

A special demonstration run in July provided a foretaste of the new British Railways schedules utilizing the 3300-hp Deltic diesel-electric locomotives. Because of the need to operate the special train between existing services it was impossible to provide exactly similar running times as those which BR is putting in effect. Nevertheless, the speeds attained and the overall performance clearly indicated the capacity of the 3300-hp Deltic locomotives. On the outward journey between London and Leeds and on the return journey to London there was sustained running at 138–141 km/h with peaks of 148–149 km/h. The 298.5 km between London and Leeds was accomplished in 186 minutes on the outward trip and 182 minutes on the return run.

The production Deltic is a remarkably compact machine being 21.18 meters long, 2.67 meters wide and 3.71 meters high. With a maximum axle-load of $16^1/_2$ tons, the all up weight in working order is only 99 tons—some 7 tons lighter than the prototype. Some of this weight reduction is accounted for by the utilization of light alloy for roof panels and the use of fiberglass for battery boxes, sandboxes, main cable ducts, instrument panels and cab and equipment compartment doors. Fuel and boiler feed water tanks are welded from non-corrosive light alloy. Further weight has been saved in the fabricated construction of the bogies which are interchangeable with the English Electric type 3 diesel-electric locomotives.

The power units consist of two Napier Deltic D18-25 engines each direct coupled to an English Electric type EE829A main generator with a type EE913A auxiliary generator driven from the engine phasing gearbox. Each main generator has a continuous rating of 1650-amps at 660-volts. Normally both main generators are connected in series and supply the six traction motors, but the locomotive can operate with either power unit running and develops full tractive effort, although at half voltage and consequent lower road speed.

The Napier Deltic engine has 18 cylinders and operates on the two stroke opposed piston principle, having a rating of 1650 hp at 1500 rpm. The cylinders are arranged in three banks of six in the form of an equilateral triangle.



English Electric is now delivering the first models of type 5 Deltic 3300-hp Co-Co diesel-electric locomotive

Voie sur béton

La 'New York City Transit Authority' met en service ce mois entre le 'Times Square' et le 'Grand Central' un train-navette automatique, dont la particularité est qu'il roulera sur une voie posée sur des plaques de caoutchouc et une dalle de béton, sans traverses. Le but de ce genre de construction est d'obtenir un roulement aussi doux que possible des véhicules, pour l'agrément des voyageurs d'abord, pour protéger ensuite autant que faire se peut les appareils de commande électroniques du train automatique et réduire au minimum les frais d'entretien.

Schienenauflage aus Beton

Diesen Monat eröffnet die New York City Transit Authority den Verkehr zwischen Times Square und Grand Central mit einem automatisierten Pendelzug, wobei als Neuerung das dazu benötigte Gleis auf Gummiplatten und eine schwellenlose Betonauflage verlegt wurde. Diese Gleisbauart bezweckt einen möglichst ruhigen Fahrzeuglauf, um neben dem Komfort für die Reisenden die elektronischen Steuerungsapparate des automatisierten Zuges nach Möglichkeit zu schonen und die Unterhaltskosten auf ein Minimum zu reduzieren.

Ensayos con asiento de concreto en EE.UU.

Este mes un tren subterráneo automatizado se pondrá en servicio en los EE.UU. Para el uso del tren una de las vías del servicio de lanzadera Times Square—Grand Central de la New York City Transit Authority ha sido reemplazada por un tramo de diseño especial. Se colocan los rieles sobre cajas de caucho y se los clava directamente a un asiento permanente. Se ha optado por el nuevo diseño en consideración a dos objetivos: proporcionar una marcha tan estable como se pueda para el tren subterráneo automático y su equipo de control electrónico; reducir al mínimo los gastos de mantenimiento.

Track Laid for Automate

An automated underground train is scheduled to enter service in the US this month. For the use of the train, one of the tracks on the New York City Transit Authority's Times Square—Grand Central shuttle service has been replaced with a track of special design. The rails are placed on insulating rubber rail seats and are bolted directly to a permanent rail bed. Joints are "frozen" by a "glued-joint" process.

The 792-m shuttle service connects two north and south underground lines and carries a heavy flow of passengers at almost any hour of the day or night. The line consists of four tracks and trains are operated from one end to the other and back without turning. Normally, three tracks are in service, with one reserved for storage.

When the decision was made to replace the conventional ballasted Track 4 with a new design, New York's maintenance-of-way engineers were faced with the problem of performing the work with a minimum disruption of service. Traffic would continue on two tracks while Track 4 was out of service.

Under the over-all supervision of W. L. Schlager, Jr, assistant general superintendent, maintenance-of-way, work was begun in May. Completion date was set for the early part of June.

The new design—in which rails mounted on insulating rubber rail seats are bolted directly to the permanent concrete rail bed—was chosen with two objectives in mind. One is to provide as smooth a ride as possible for an automatically operated underground train and its electronic control equipment and the other is to reduce maintenance costs to a minimum.

The existing track is laid on the permanent concrete foundation of the shuttle tunnel. The work of constructing the new track was progressed in 182.8-m sections.

Lengths of new 45.3 kg ARA-B rail were brought in and unloaded where they were to be used. The old track was then dismantled. A special car with a 12-m extension boom was used for loading the rail. Sleepers were picked up and loaded on a work train on Track 2. (Track 2, which does not have platform facilities for passengers, had to be used for the work train, while Track 3, which lies

Special rail handling car with capacity of 40 tons picked up dismantled rails

ubway Train

between Track 2 and Track 4, was kept in service.)

With the rail and sleepers removed, a front-end loader was brought in to clean out the ballast. As each of the 182.8-m sections was cleaned in turn, concrete pedestals for supporting the rail while the concrete rail bed was being built were brought in and put in place. The new rail was placed on the concrete pedestals and then blocked and shimmed in place.

Insulating rubber rail seats, manufactured by Railroad Rubber Products Company, USA, to Mr. Schlager's specifications, were applied to the base of the rail at the rate of 14 to each 11.8-m rail length. These are 30.4 cm by 22.5 cm by 4.7 cm in size and have double shoulders that lap over the top of the rail base. Four bolts were inserted through each plate with the heads bearing against a fibre plate placed on top of the rubber.

With the rail seat-and-bolt assemblies in place on the rail bases, and with the rails shimmed in position, work could proceed on the construction of forms for the concrete rail bed. These were required mainly to make provision for a gutter, 10 cm deep and 69 cm wide, between the rails. Concrete was delivered in transit-mix wagons to manhole locations where it could be chuted down in buggies operating on the track being constructed. The concrete was placed up to the bottoms of the rubber sleeper plates, thus giving the rail bed a depth of about 20 cm. The width is about 2.7 m.

When the concrete had set and the track had been cleaned up, the rail joints were "frozen," using the US Rail Joint Company's process and Bondarc bonding material. The joints are square.

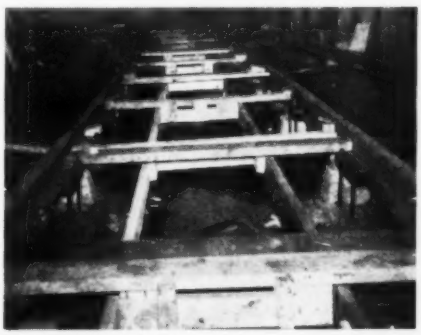
The new type of track, says J. J. Quinn, superintendent of track and structures of the Transit Authority, is also applicable to other sections of the underground. If it proves successful, the design will be used to replace other sections of conventionally ballasted track.

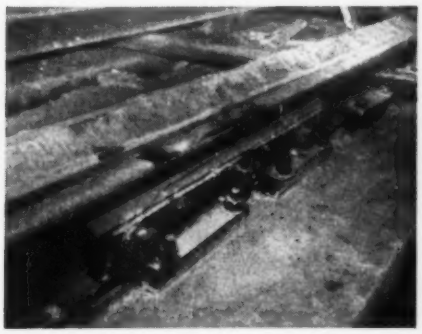
The Transit Authority has had another type of rubber-mounted rail in service on another shuttle track for almost two years. This, a 55-m section, differs from the current installation in that it was constructed with steel channel sections extending between the piers, which the present installation does not have. The first section has worked very well, Mr. Quinn reports.

The new track has a permanent concrete rail bed to which rail is fixed

The old track was removed and ballast cleared from the tunnel before . . .

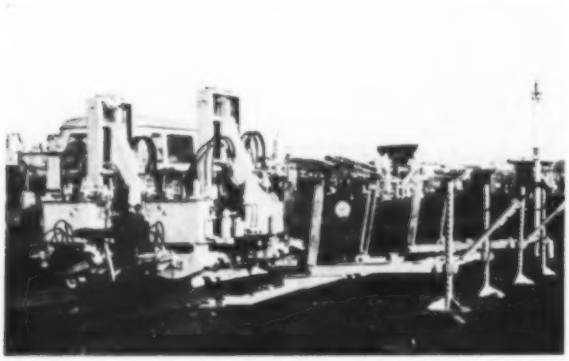
. . . the pedestals could be lined up and rail with rubber rail seats installed;





. . . concrete was then poured over wood frames to form 20 cm deep rail bed

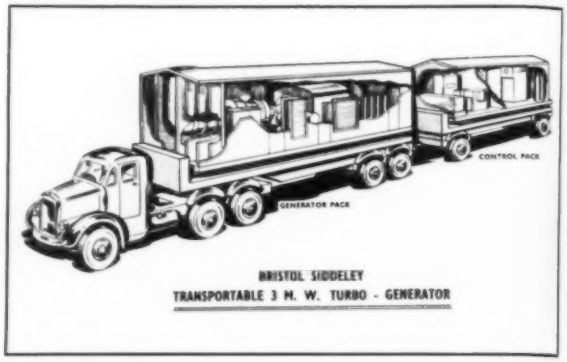
Products of Interest



Small Tamper With Full Size Units

Petite bourreuse à un agent et à bourreurs normaux.
Kleine einmännig bediente Krampmaschine mit Normalstopfern.
Pequeña apisonadora manejada por un solo hombre.

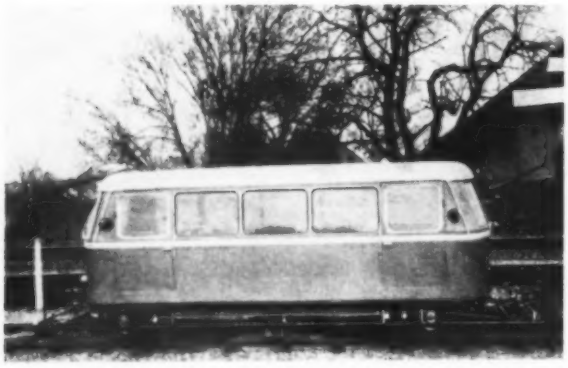
Plasser & Theurer is now marketing a one-man small tamping machine with full size heavy tamping units. It is suitable for wooden, steel and concrete sleepers and is available for standard, wide or narrow gauge. Four hydraulic clamps lock the machine in position. Each of the two tamping units weighs about 213 kg and machine output can reach up to 122 m/h depending on sleeper pitch. *Plasser Railway Machinery Ltd., England.* **IRJ 1**



No Off-Loading For Mobile Generator

Turbo-générateur mobile prêt à l'emploi sans déchargement.
Fahrbarer Turbogenerator ohne Ablad einsatzbereit.
No hace falta descargar este turbogenerador móvil.

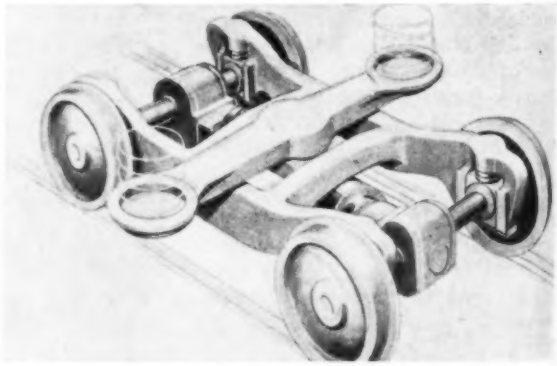
The Bristol Siddeley mobile 3MW turbo-generator can be loaded on to a standard road transporter or railway flat car, for use at any point on the road or rail system without off-loading or jacking. The basic generator pack, containing the Bristol Siddeley Proteus gas turbine and alternator, is 10.36 m (34 ft) long, 2.7 m high (9 ft) and 2.7 m wide. The control pack is for use where suitable control equipment is not readily available. *Bristol Siddeley Engines Ltd., England.* **IRJ 3**



Mobile Lab For Track Inspection

Wagon de mesure NCG-Amsler pour le contrôle des voies.
NCG-Amsler-Messwagen für Geleisekontrolle.
Laboratorio móvil NCG-Amsler para inspección de la vía.

First product to be built in the US under an agreement between the National Cylinder Gas Division of Chemetron Corp., US, and Alfred J. Amsler & Co., Switzerland, is the NCG-Amsler Track inspection car, a mobile laboratory for determining the condition of railway track. It simultaneously measures gauge, gradient, curvature, twist and distance traveled. All track information is continuously recorded. *National Cylinder Gas Division, USA.* **IRJ 2**



Lightweight Passenger Car Bogie

Nouveautés américaines dans la construction de bogies.
USA-Firma meldet neue Entwicklungen im Drehgestellbau.
Nuevo desarrollo en diseño de bogies de casa norteamericana.

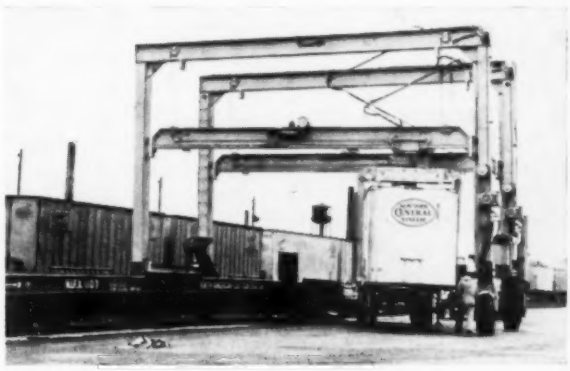
A "family" of bogies—designated General 70—has been introduced as a new development in bogie design. Major innovation is an arrangement of bolster springs between the car body and bogie bolster. General 70 offers a high degree of roll stability with soft vertical springing, factors usually obtained at mutual expense in conventional bogie design. The bogie is applicable to almost all kinds of rail service. *General Steel Industries, Inc., USA.* **IRJ 4**

From Railway Suppliers

High Speed Freight Locomotive

Nouvelle locomotive pour trains de marchandises accélérés.
Neue Lokomotive für Eilgutzüge.
Nueva locomotora para servicio de carga, régimen exprés.

The new 2400-hp diesel-electric locomotive designated Model DL-640 has been built for high-speed, priority-freight service. Powered by a 16-cylinder, turbosupercharged diesel engine, the DL-640 unit has four traction motors, each delivering 600 horsepower. The new units weigh approximately 128 tons. Four of the new models have been ordered by the Union Pacific Railroad in the United States and were to be delivered during August. *Alco Products, Inc., USA.* **IRJ 5**



Faster Piggyback Unloading

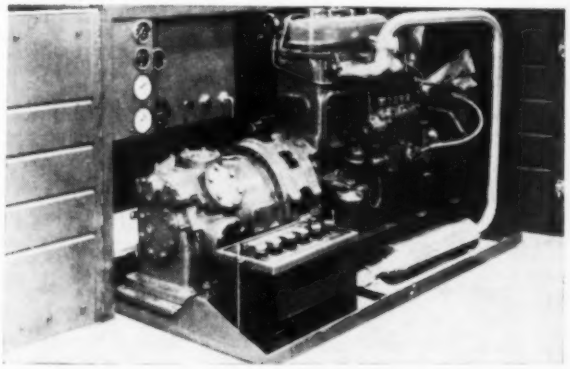
Nouveau piggyback supprimant presque tout transbordement.
Neue Ausrüstung für raschen Auslad im Huckepackverkehr.
Equipos para operar el sistema a caballo permiten descarga rápida.

New developments in piggyback handling provide faster loading and unloading at terminals. New model SPL 40ACW unit has a variable drive that permits angular loading. By this method trailers can be handled in any desired order, without waiting for the complete unloading of the train. The unit handles trailers up to 36,280 kg and 12 m (40ft) length, in addition to containers of similar size. *Travelift Division of Drott Mfg. Corp., USA.* **IRJ 7**

Chain Roller Dri-Loob

Dispositif de graissage protégeant une commande par chaîne.
Schmiervorrichtung schützt Kettenantriebsausrüstung.
Lubricador protege equipo accionado por motor-cadena.

Spray Chain Roller Dri-Loob has been developed for motor-chain-driven equipment needing maximum protection from friction, rust and the elements. It protects brushes, paddles, or grease guns, and does not collect dirt or dust. Spray-on application enables it to lubricate hard-to-reach areas. It should be sprayed from a distance of several inches in short bursts and allowed to set before putting motor-chain into action. *Spray Products Corp., USA.* **IRJ 6**



Refrigeration-Heating System

Une petite installation de réfrigération prend peu de place.
Kleinanlage für Kälteerzeugung fordert wenig Raum.
Sistema ligero de refrigeración ocupa poco espacio.

The Worthington TDU-800 refrigeration system is applicable for use on highway and piggyback trailers. When installed, it is said to weigh 300 lb less than other competitive systems of equivalent capacity. It is also claimed that it takes up 50% less loading space. It consists of a diesel engine driven condenser unit and evaporator designed to maintain temperatures from minus 23 to 23 C°. Automatic defrost controls are provided. *Worthington Corp., USA.* **IRJ 8**

World Market CONTINUED

▶ *Iraq*—Plans to spend some 30,000,000 dinars over the next five years on railway expansion. The program will be financed by USSR and Czechoslovakian loans. Iraq has already ordered 25 diesel locomotives from Russia plus 20 1672-hp diesels and five 760-hp shunting locomotives from Czechoslovakia. The USSR is providing technical assistance in the rehabilitation and reequipping of the line between Basrah and Baghdad, as well as extension of the line to the new port city of Um Qasr. Iraq is also reportedly negotiating with Russia for assistance in the establishment of a new diesel locomotive repair shop.

▶ *Ireland*—Coras Iompair Eireann plans to purchase approximately 100 new passenger cars within the next few years. Initial procurement will include 10 completed and 30 partially completed steel railway coaches. The agency intends to make arrangements for the manufacture of these vehicles in Ireland with a licensing agreement under which all required construction equipment and technical assistance would be supplied. Bids must reach the Secretary, CIE, Kingsbridge Station, Dublin 8, before 18 October.

▶ *Israel*—Israeli Railways has ordered 14 passenger coaches from the French firm of Carel Fouche. Design follows UIC standards and bogies are of the German Minden-Deutz pattern. Each car is 25.4 meters long, has a tare weight of 33 metric tons and seats 96 passengers.

▶ *Liberia*—Work has begun on a 250-km railway from Lower Buchanan to the mining center of Nimba.

▶ *Mexico*—Ferrocarril del Pacifico will spend 37.5 million pesos on improvements this year. Projects include modernization of the classification yard at Nogales, construction of railway stations and track improvements.

The Ciudad Sahagun Railroad Car Construction Plant, built in 1955, has turned out over 8,500 cars. Scheduled production for 1962 is 1,260 box cars, 200 gondola cars, 513 stock cars and 90 passenger coaches.

▶ *Nigeria*—The Nigerian Railway Corp. has obtained a loan of $3.1 million from the US Development Loan Fund for relaying of track between Enugu and Makurdi (124 km) and between Minna and Kaduna (159 km). The entire track-relaying program will extend over 964 km and will cost as estimated $26 million (US).

▶ *Peru*—A $1.5 million (US) Export-Import Bank credit will be used to finance the purchase of six diesel locomotives and spare parts. The acquisition is part of a modernization program that will cost $16.3 million.

Japanese interests have stated that they are prepared to invest some $30 million in railway construction in Peru if satisfactory arrangements can be made with the government. Mitsubishi Shoji Kaisha Ltd. has started construction of a $4 million expansion of the Cuzco-Santa Anna railway.

▶ *Poland*—During the first half of this year Poland produced 24 electric locomotives, as against 19 during the same period last year. Steam locomotives over the same period rose from 48 to 55 units, while freight cars produced dropped slightly from 7,000 to 6,900 units.

The Polish Railway Development Institute is working on plans for the building of diesel locomotives in the 150—1,000-hp range and a 150-hp railbus.

▶ *Rhodesia*—Rhodesia Railways have ordered 30 diesel-electric locomotives to cost £2.5 million from English Electric Co. Ltd. and Brush Electrical Engineering.

▶ *Yugoslavia*—Under contracts signed during the first quarter of 1961, the rolling stock industry is to export this year 900 tank cars, 160 freight cars, 200 cars for the transportation of cement, 50 for coal, 70 for lime, 150 open cars and 12 passenger coaches.

Correction: IRJ regrets that an item in the Aug./Sept. issue concerning the awarding of a contract for hotbox detector equipment to Servo Corp. of America by the Indian Railways was incorrect.

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COMPUTERS
CONTINUED

found to be relevant to the original meet being established, i.e., they also involve one of the two trains involved in the original meet, the program then comes back and investigates not just the original two-train combination but also the additional combinations produced by the introduction of the additional train.

"This group of tentative meet assignments is then reviewed by an expanded evaluation process to choose the optimum allocation of train-siding combinations. If this deeper level of investigation leaves the original tentative assignment of a train to a siding unchanged, the meet is firmly established at that point. The decision is recorded in the decision planning record and control returns to main program."

The Japanese National Railway Technical Research Institute, which started research with the object of mechanizing calculations to obtain train performance curves, first completed a computer working on a mechanical system; then an electro-mechanical one and has at last worked up to an electronic computer. This computer, designed for solving the train motion equation, is a kind of analogue computer in which all the functional values except the time variable are represented by corresponding voltage values. By reading changes in these voltage values according to the time variable, you may obtain the relations between the speed of the train, the distance passed by the train and the power consumed.

The figure on page 23 is a block diagram showing its structure. The generators T, R, G and B in the figure automatically change their own values in accordance with the values of speed 'v' and distance 'S' as they are computed by the computer. In the generator T, the tractive power characteristic is set in advance as resistance value by a pre-patch board; in the generator R, the coefficient value of the running resistance formula (quadratic expression) is pre-set by the potentiometer; and in the generator G, the gradient and the kilometrage are punched on a paper tape in advance; and these are read and changed into analogue voltage through a combination of relays. The generator B sets the value for each train by potentiometer. Before starting the operation of the computer, put on V_0 and S_0, then T (V_0), R (V_0) and G (S_0) are set up accordingly. With these starting values given, the computer is put in motion. Then the adder sets up the voltage values corresponding to the right side of the equation; these values enter the integrator as input and provide the integrated result, or the voltage value representing the speed v that corresponds to the starting values mentioned above. The result is put in the second integrator and S is obtained as the output in the form of a voltage value. When v and S are obtained in this way, the functional values on the function generator are changed to new values corresponding to the values of c and S through an electric circuit or servo mechanism. Meanwhile, the computed v and S move the pen of the recorder which is running at a fixed speed. At the same time, the X-axis of the XY-recorder is moved in proportion to S and the Y-axis is moved in proportion to v. In this way, the curves showing the relations of t-v, t-S and S-v are automatically drawn on the recorders. Furthermore, when the speed v is computed, the current value i (v) is set by the current function generator. This is integrated and the electric power consumed for train operation Q(t) is obtained. The result appears on the recorder as a t-Q curve.

The train performance calculator described above began to be operated in June, 1958, at the Train Operation Department of the JNR Head Office. It was found to be satisfactory for a tentatively designed piece of equipment. From actual use for about two years, it has become clear that the demand for calculation of speed-distance curve and 'load curves' was the largest in practice. By the term speed-distance curve is meant the group of speed-distance curves for different gradients. The 'load curve' means the curve that represents the relation between the tractive load and the balancing load for each gradient. Now that the practical utility of a computer for obtaining speed-distance curves for various gradients has become quite obvious, the JNR Research Institute has set about working up a computer for practical use, making the most of the experience acquired in producing the tentative computer.

The principle of the fundamental running curve calculator is nearly the same as that of the train performance calculator. By adding a few devices, you will get a computer capable of drawing the 'load-curve,' the accelerative force curve ($\frac{T-R}{W}$ is taken at the ordinate and v at the abscissa) and the running resistance curve.

JNR, like other railway systems, has also been conducting studies of programming for digital-type electronic computers in an attempt to obtain train-operation curves.

"In computing a train performance curve" says JNR's Tadayoshi Kohno, "the basic question is how the operating conditions are given. The operating conditions here referred to imply the initial point of coasting operation, powered operation, braking etc. We indicate through the parameter of distance at what point the train is powered and at what point it is braked. Our program takes the following course: As is generally known, speed limits are set at various stretches on a railway track. In order to pass a speed-limit post at a speed conforming to the given condition, it is necessary to shift from powered operation to coasting operation or put on the brake at some distance this side of the limit post. In making a computer perform this function, we form a judgement according to calculations conducted on the basis of energy. The data of track gradients and speed limits are punched on a tape so as to be read by the computer as needed. The punched tape bears only the values peculiar to a special track, so that it can be used for all kinds of railcars that run on the track. In other words, each tape represents a section of a track and is applicable to all kinds of trains in the computation of their operation curves. As for the types of trains of cars, another punched tape is prepared for each kind, so that you need not put on the data every time a computation is done. What you have to insert at each computation are stations and the times of stops, maximum speed, weight of the train and the number of cars, and other particulars involved in train operation.

"In order to ensure the simulation of a group of trains, the fundamental problem is to solve a group of differential equations. It takes too much time for a digital-type electronic computer to carry out this work. For the purpose we shall have to get a super-high-speed computing apparatus of large memorizing capacity involving an enormous sum of money. Moreover, we must take a great deal of trouble to prepare the program. As a result of these studies, the Research Institute has set about the task of developing a simulator that meets the purpose. Already the blueprints have been completed and trial manufacture will be started soon. This simulator comprises a calculating differential analyzer as the sub-computer and a general purpose electronic computer as the parental computer. The two computers have in common a part of the internal drum memory. There is, in addition, a system of external memorizing devices in the form of magnetic tape and an output recorder which draws the result in diagram. It is expected that the completion of this apparatus will afford extremely useful data."

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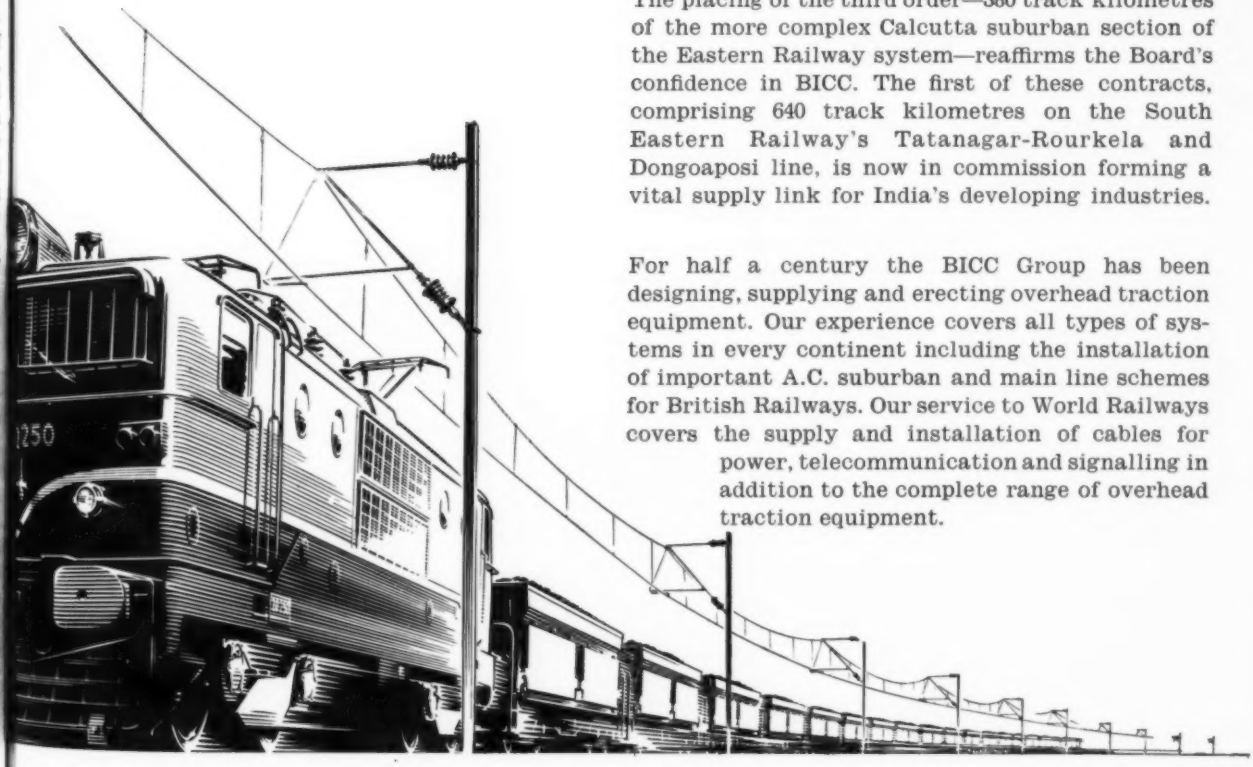

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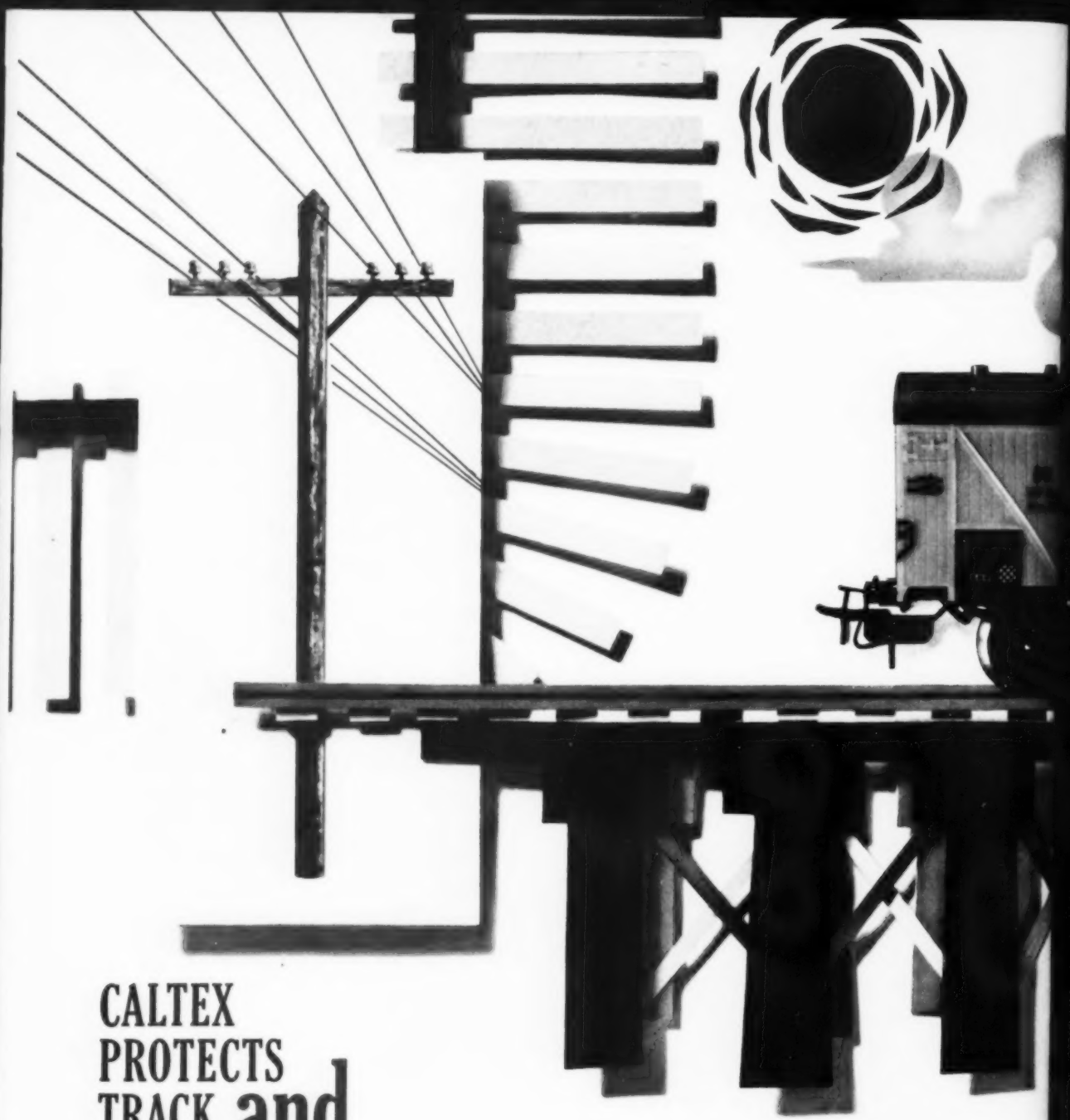

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